



Making Globalization Work Better for the Poor through CONTRACT FARMING

Edited by:
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ADB



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Printed in the Philippines.

ISBN 978-92-9254-612-0 (Print), 978-92-9254-613-7 (e-ISBN)
Publication Stock No. BKK135593-2

Cataloging-In-Publication Data

Asian Development Bank.

Making globalization work better for the poor through contract farming.
Mandaluyong City, Philippines: Asian Development Bank, 2014.

1. Contract farming. 2. Inclusive growth. 3. Global agrifood value chain. I. Asian Development Bank.

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Contents

<i>Tables, Figures, Boxes, and Appendixes</i>	<i>vii</i>
<i>Foreword</i>	<i>xiii</i>
<i>About the Editors</i>	<i>xv</i>
<i>About the Contributors</i>	<i>xvii</i>
<i>Abbreviations</i>	<i>xix</i>
<i>Introduction</i>	<i>xxiii</i>

PART I OVERVIEW OF CONTRACT FARMING AND REGIONAL COOPERATION

1 Global Partnership in Poverty Reduction: Contract Farming and Regional Cooperation <i>S. Setboonsarng</i>	3
2 Overview of Contract Farming in Thailand: Lessons Learned <i>S. Sriboonchitta and A. Wiboonpongse</i>	27

PART II CONTRACT FARMING EXPERIENCE IN SELECTED ASIAN COUNTRIES

3 Methodology and Empirical Methods to Mitigate Selection Bias <i>P.S. Leung and J. Cai</i>	53
4 Contract Farming and Poverty Reduction: The Case of Organic Rice Contract Farming in Thailand <i>J. Cai, S. Setboonsarng, and P.S. Leung</i>	71
5 Rice Contract Farming in Lao PDR: Moving from Subsistence to Commercial Agriculture <i>S. Setboonsarng, A. Stefan, and P.S. Leung</i>	109
6 Rice Contract Farming in Cambodia: Empowering Farmers to Move Beyond the Contract Toward Independence <i>J. Cai, L. Ung, S. Setboonsarng, and P.S. Leung</i>	133

PART III TRACEABILITY SYSTEMS AND GLOBAL AGRIBUSINESS TRADE REGIME

7	Standards and Agricultural Trade in Asia <i>D. Giovannucci and T. Purcell</i>	171
8	Food Safety and Information and Communication Technology Traceability Systems: Lessons from Japan for Developing Countries <i>J. Sakai, S. Setboonsarng, and L. Vancura</i>	205
9	International Supply Chain Management through Contract Farming: Experience of Japanese Firms in Selected Asian Countries <i>S. Setboonsarng</i>	231

PART IV EVOLVING FORMS OF CONTRACT FARMING PRACTICES

10	Is a Written or Verbal Contract Better for Farmers? Case Study of Asparagus Contract Farming in Thailand <i>T. Munjaiton, J. Cai, S. Setboonsarng, and P.S. Leung</i>	273
11	International Social Contract Farming: Case of Banana Export from Thailand to Japan <i>T. Munjaiton, S. Setboonsarng, and P.S. Leung</i>	299

	<i>Glossary</i>	329
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	<i>Index</i>	335
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Tables, Figures, Boxes, and Appendixes

FIGURES

1.1	Stages of Market Development and Contract Farming	6
2.1	Examples of Various Types of Contract Arrangements in Thailand	32
2.2	Farmers' Reasons for Participating in Contract Farming	37
5.1	Average Sources of Rural Household Income in the Lao PDR	111
5.2	Average Sources of Income of Surveyed Households	117
5.3	Profitability Comparison of Contract and Noncontract Farmers	125
7.1	Output Structure in PRC Food-Processing Industries, Percentage of Total 1998–2003	174
7.2	Growth in Supermarkets on a Regional Basis, 1997–2002	179
8.1	Food Supply Chain	207
8.2	Schematic Diagram of Oita Mushroom Traceability System	217
9.1	Growth in Consumption of Healthy Foods	233
9.2	Level of Concern on Food Safety of Japanese Consumers	234
9.3	Dominant Safety Concerns on Food Imports into Japan	234
9.4	Confidence Level and Purchases of Local and Imported Food	235
9.5	Food Traceability System	236
9.6	Organic JAS Logo and New JAS Standard Logo	237
9.7	Trading Partners Using Multiple Responses	244
9.8	Distribution of Surveyed Firms by Import Value, 2004	245
9.9	Source of Supply	247
9.10	Traceability and Certification	248
10.1	Asparagus Production in Thailand, 1988–2010	275
10.2	Asparagus Distribution Channels	279
11.1	Fundamental Aspects of the <i>Teikei</i> System	301
11.2	Total Banana Production in Thailand (1965–2010)	302

TABLES

1.1	2005 Pilot Projects in Contract Farming Firm under ACMECS	19
2.1	Net Return per Rai from 1984/85 to 1990/91	39
2.2	Comparison of Contract and Noncontract Potato Production in Chiang Mai Province (2006)	42
4.1	Potential Benefits of Contract Farming	73
4.2	Distribution of Sampled Rice Farms by Region, Province, and Special Groups	79
4.3	Characteristics of Sampled Farms	81
4.4	Estimated Profit Elasticities for Farms	84
4.5	Profitability of Rice Farming in Sample Farms	86
4.6	Profitability by Farm Size	88
4.7	Counterfactual versus Actual Profits	89
4.8	Profit Efficiency of Contract versus Noncontract Rice Farmers	90
4.9	Profit Efficiency by Farm Size	91
4.10	Profit Efficiency by Different Stages of Organic Farming	92
4.11	Counterfactual vs. Actual Efficiency	93
5.1	Household Characteristics	116
5.2	Commercial Production: Revenue, Cost, and Profit	119
5.3	Material Cost Structure for Commercial Operation	120
5.4	Labor Cost Structure for Commercial Operation	121
5.5	Propensity Score Matching Comparison of Contract and Noncontract Farms	123
6.1	Farmers' Characteristics	137
6.2	Farm Production: Revenue, Cost, and Profit	141
6.3	Labor Cost	144
6.4	Material and Operating Cost Structure	145
6.5	P-score Comparison of Contract and Never-Contract Farmers (Entire Operations)	150
6.6	P-score Comparison of Contract and Former-Contract Farmers (Commercial Operations)	152
6.7	P-score Comparison of Contract and Former-Contract Farmers (Entire Operations)	154
6.8	The Selection Function	156
6.9	Profit Functions under Contract and Without Contract	157
6.10	Profitability Comparison based on Switching Regression	158
7.1	Characterizing Different Types of Standards	175
7.2	Comparative Overview of Some Popular Process or Sustainability Standards	183

8.1	Traditional vs. ICT Methods of Traceability Documentation	210
9.1	Number of Imported Items by Country Using Multiple Responses	245
9.2	Factors Assessed and Satisfaction Ratings of Japanese Companies	249
9.3	Possible Areas for Technical Support	252
10.1	Farm Household Characteristics	282
10.2	Access to Credit	283
10.3	Farm Production: Revenues, Costs, and Profits	286
10.4	Labor Cost Structure	287
10.5	Material Cost Structure	288
10.6	Productivity of Asparagus	289
10.7	Results of Logit Estimation of a Farmer's Contractual Choice	290
10.8	Propensity Score Matching Comparisons: Written Contract vs. Verbal Contracts	291
11.1	Socio-Demographic Profile of Respondents	310
11.2	Availability and Nature of Credit	311
11.3	Revenue, Cost, and Profit from Banana Growing	312
11.4	Labor Cost Structure	313
11.5	Material Cost Structure	314
11.6	Propensity Score Matching Comparisons: Contract vs. Noncontract	316

BOXES

7.1	Supermarkets Emerge in the United States and Explode in Latin America and Asia	178
7.2	Thailand Case Study	189
7.3	People's Republic of China Case Study	189
7.4	Indonesia Case Study	190
9.1	Traceability Systems in Japanese Supermarkets	237

APPENDIXES

Chapter 4

Tables

A1	Maximum Likelihood Estimates of Stochastic Profit Frontier and Inefficiency Effects Model (Contract vs. Noncontract)	98
A2	Summary Statistics of Variables Used in Frontier Estimation (contract farms)	101

A3	Summary Statistics of Variables Used in Frontier Estimation (contract farms)	102
A4	Costs and Returns of Rice Farming in Thailand	103

Chapter 5

Tables

A1	Endogenous Switching Regression Estimation Results (Lao PDR Conventional Rice Farming)	130
A2	Profit Functions	131

Chapter 6

Appendix

1	Switching Regression Methodology	164
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Chapter 9

Appendixes

1	Definition and Flowchart of Traceability System	263
2	The Traceability System Flowchart	263
3	Developments in Traceability Technology	264
4	Survey Tables	267
5	Survey Figures	268

Tables

A3.1	Comparison of Traceability Devices	265
A4.1	Distribution of Survey Instruments by Sector	267
A4.2	Major Imported Items by Country	268

Figures

A3.1	Examples of Documentation for Traceability System	266
A5.1	Distribution of Respondents by Industry (N = 59) and by Capital Size (JPY)	268
A5.2	Degree of Processing	269
A5.3	Type of Traceability and Organic Certification	269
A5.4	Method of Ensuring/Verifying Traceability and Certification	270

Chapter 10

Tables

A1	Green Asparagus Grading System Used by Swift Co., Ltd.	296
A2	Description of the Estimated Propensity Score Matching Function	297

Chapter 11

Appendixes

1	A Summary of the Ten Principles of <i>Teikei</i>	319
2	Commercial Varieties of Banana	320
3	Banlat Farmers' Group/Cooperative	320
4	Dynamics in Banlat Contract Farming	321
5	Roles of Actors in the Case Study	323
6	Overview of Contract Farming in Thailand	325

Table

A3.1	Membership Size of Each Subgroup of Banlat Farmers' Cooperative	320
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Foreword

Agriculture is increasingly called upon to deliver inclusive growth as growth originating from the sector has been found to be 2–4 times more effective at reducing poverty than that from other sectors. As agriculture employs up to 75% of rural populations in developing countries, of particular interest to policy makers is how the private sector can be effectively engaged in addressing the fundamental needs to improve productivity and market access for smallholders, as well as deliver agricultural public goods.

In recent decades, market-based institutional arrangements such as contract farming have been proliferating in the region. Contract farming, which links farmers and buyers, offers a promising potential in the elusive quest for agricultural development in a time of globalizing agritrade. Contract farming is one of the effective development tools that engage the private sector in rural development. Contracting firms provide smallholders with technology and market information, thereby increasing remunerative new markets. Farmers in turn deliver specified quality produce at an agreed price, volume, and schedule to contracting firms. Returns are maximized for smallholders who are then able to transform their traditional farming practices into market-oriented commercial production, linking them to global agrifood value chains. With consumers in lucrative markets demanding more safe food grown responsibly, the proliferation of organic contract farming in particular can make the agriculture sector essential to green and inclusive growth.

The concept of contract farming is not entirely new. Case studies in various countries such as Cambodia, the Lao People's Democratic Republic, and Thailand have already been published by the Asian Development Bank and the Asian Development Bank Institute. This compendium abstracts the lessons learned and synthesizes the conditions for successful and effective contract farming arrangements and how they greatly depend on an enabling environment facilitated by governments. With governments effectively supporting the private sector, contract farming can offer marginal farmers the chance to produce beyond subsistence levels in a sustainable manner, which can transform lives and enhance dynamic bases in rural communities.

As the Southeast Asian region faces more challenges to meet growing food demand, with risks from natural resource scarcity, shocks from food price volatility, accelerating climate change, and increased market risk, it is essential to gain a better understanding of how contract farming could be effectively implemented as a development tool in offering opportunities for the region to rise as a hub for green and inclusive growth.

Yet, contract farming is not a one-size-fits-all solution to rural development. Rather, it is an institutional arrangement that, when properly implemented by the private sector with appropriate government support, can unlock agribusiness dynamism and green transformation. The goal is to share these findings with stakeholders to make contract farming work better for smallholders, for the environment, for more safe food, and for inclusive growth. It is our hope that this publication can contribute in the ongoing efforts toward an Asia and Pacific region free of poverty.

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Abbreviations

ACMECS	–	Ayeyawady–Chao Phraya–Mekong Economic Cooperation Strategy
ACT	–	Agriculture Certification Thailand
ADB	–	Asian Development Bank
ADB I	–	Asian Development Bank Institute
AFTA	–	ASEAN Free Trade Area
AKR	–	Angkor Kasekam Roongroeng
APB	–	Agricultural Promotion Bank
ASEAN	–	Association of Southeast Asian Nations
BAAC	–	Bank for Agriculture and Agricultural Cooperatives
BAC	–	Banlat Agricultural Cooperatives
BIOTEC	–	National Biotechnology Center
BOI	–	Board of Investment
BRC	–	Brazil, the Russian Federation, and the PRC
PRC	–	People’s Republic of China
CIAT	–	International Center for Tropical Agriculture
CIES	–	International Committee of Food Retail Chains
COSA	–	Committee on Sustainability Assessment
CSA	–	community-supported agriculture
CSR	–	corporate social responsibility
EIC	–	Economic Institute of Cambodia
EU	–	European Union
EUREP	–	European Retailers Group
FAO	–	Food and Agriculture Organization
FDI	–	foreign direct investment
FFV	–	fresh fruit and vegetables
FLO	–	Fairtrade Labeling Organizations International
FMRIC	–	Food Marketing Research and Information Center
FSC	–	Food Safety Commission
FTAs	–	free trade agreements
GAHP	–	good animal husbandry practice
GAPs	–	good agricultural practices
GDP	–	gross domestic product
GMO	–	genetically modified organism
GMP	–	Good Manufacturing Practice
GMS	–	Greater Mekong Subregion
GPS	–	global positioning system
ha	–	hectare
HACCP	–	Hazard Analysis and Critical Control Points
IBS	–	IFOAM Basic Standards
ICT	–	information and communication technology

IFAD	– International Fund for Agricultural Development
IFOAM	– International Federation of Organic Agriculture Movements
IFPRI	– International Food Policy Research Institute
IGD	– Institute of Grocery Distribution
IPPC	– International Plant Protection Convention
IRRI	– International Rice Research Institute
ISEAL	– International Social and Environmental Accreditation and Labeling
ISO	– International Organization for Standardization
JAS	– Japanese Agricultural Standards
JETRO	– Japan External Trade Organization
JOAA	– Japan Organic Agriculture Association
kg	– kilogram
km	– kilometer
LAI	– Lao Agro Industry Co.
Lao PDR	– Lao People’s Democratic Republic
MAFF	– Ministry of Agriculture, Forestry and Fisheries
MDGs	– Millennium Development Goals
MFI	– microfinance institution
MHLW	– Ministry of Health, Labor and Welfare
MNC	– multinational corporation
MOAC	– Ministry of Agriculture and Cooperatives
MOU	– memorandum of understanding
MPDF	– Mekong Private Sector Development Facility
MRL	– maximum residue level.
NAFTA	– North American Free Trade Agreement
NCF	– noncontract farming
NEM	– New Economic Mechanism
NESDB	– National Economic and Social Development Board
NGO	– nongovernment organization
NIE	– new institutional economics
ODA	– official development assistance
OIE	– Office International des Epizooties
OTA	– Organic Trade Association
PPFC	– Pan Pacific Food Corporation
PSM	– propensity score matching
RFID	– radio frequency identification
SCC	– Shutoken Consumers Cooperative
SEDS	– Socio-Economic Development Strategy
SEFCP	– State Enterprise and Food Crop Promotion
SMEs	– small and medium-sized enterprises
SPS	– sanitary and phytosanitary
SPT	– sufficient processing threshold
TBT	– Technical Barriers to Trade
TRF	– Thailand Research Fund

UNDP	–	United Nations Development Programme
USDA	–	United States Department of Agriculture
VACVINA	–	National Association of Vietnamese Gardeners
WHO	–	World Health Organization
WTO	–	World Trade Organization

Note:

In this publication, “\$” refers to US dollars.

Introduction

The Asia and Pacific region is now the fastest growing region in the world economy. Despite the economic success, around 733 million still live on less than \$1.25 a day. While improved agricultural productivity has played a role in reducing the number of the poor, the conventional practice of agriculture has restricted its potential to stem growing inequalities and has expanded its role in harming the environment. Solutions to end extreme poverty are compounded by the degradation of natural resources that underpin agricultural productivity with the added risk of climate change, which is one of today's most pressing challenges.

Much of the poverty in the region remains in the rural areas where agriculture is the main source of employment. The sector employs about 43% of the labor force or roughly 700 million.¹ Compared to other sectors, agriculture has been found to be 2–4 times more effective in reducing poverty given the same level of investment.² Hence, investments that transform agriculture into a sector that offers inclusive and green growth can greatly reduce poverty in the poorest regions. To achieve this, new approaches based on public–private partnerships focusing on market-oriented production and improved market access must be promoted, particularly among small-scale farmers who form the majority of the rural poor.

In recent decades, market-based institutional arrangements such as contract farming have been proliferating in the region. Much of its popularity is due to the many cases illustrating it as a model of inclusive business; one that is financially viable, can generate higher development impacts than other models, and provides needed services to the poor. Under contract farming arrangements, the private sector becomes a development partner of the government. Governments provide the needed support to create an enabling environment allowing the private sector to maximize the benefits of their investments toward inclusive and green growth. Such initiatives under public–private partnerships hold promise to all those involved along the value chain and can uplift the lives particularly of small farmers and suppliers. Benefits can multiply with the private sector facilitating the

¹ Footnote 1.

² World Bank. 2008. *World Development Report 2008: Agriculture for Development*. Washington, DC: World Bank. (<http://documents.worldbank.org/curated/en/2007/01/8711994/world-development-report-2008-agriculture-development> accessed June 2013)

integration of these marginalized segments into the global economy and help them reap the gains from trade.

While contract farming has been expanding in the region, evidence of its success and/or failure has been anecdotal. To contribute toward evidence-based policy formulation on contract farming in developing member countries, this compendium serves as a handy introduction to the subject using empirical evidence based on rigorous methodologies (propensity score matching method and switching regression) and offers insights to better understand the constraints, benefits, and potentials of contract farming. Particularly interesting to governments are the case studies in developing countries whose conditions are similar to their own, and how contract farming can fit into their national development strategy. The development community in general, as well as those in the private sector who are keen to engage in contractual farming arrangements, will benefit from the lessons learned in these case studies.

The chapters in this compilation, which include previously published Asian Development Bank Institute working papers, aim to provide a comprehensive treatment based on empirical studies, shedding light on how contract farming can be effectively utilized to achieve meaningful and inclusive growth in the rural communities. This compilation has four parts: (i) Overview of Contract Farming and Regional Cooperation (Chapters 1–2); (ii) Contract Farming Experience in Selected Asian Countries (Chapters 3–6); (iii) Traceability Systems and Global Agribusiness Trade Regime (Chapters 7–9); and (iv) Evolving Forms of Contract Farming Practices (Chapters 10–11). The hope is for the chapters in this compendium to serve the enthusiasts and practitioners in government, the private sector, and civil society in order to better understand contract farming for its effective implementation toward inclusive and green growth.

Part I has two chapters which provide the theoretical background on contract farming, roles of the public and private sectors, regional cooperation, and contract farming in the long term. The first chapter by Sununtar Setboonsarng discusses the evolution of contract farming, importance in different stages of market development, benefits to involved parties, as well as its issues and solutions using the experience of transitional economies in Southeast Asia, i.e., Cambodia and the Lao People's Democratic Republic (Lao PDR).³ The chapter points to contract

³ Cambodia became a member of the World Trade Organization in 2004, while the Lao PDR attained membership status in February 2013.

farming of organic crops as a promising option for poor farmers given that the practice is consistent with low-input traditional farming associated with lower health and environmental risks. The experience reveals the crucial roles governments play to make contract farming work, particularly in transition economies where the creation of legal safeguards and provision of basic infrastructure are crucial factors for the private sector to operate. Contract farming also has implications for regional cooperation, particularly among contiguous countries. More experienced countries in contract farming with well-established market linkages but facing land and labor constraints could partner with countries where such factors of production are readily available.

The second chapter by Songsak Sriboonchitta and Aree Wiboonpoongse reviews related literature on contract farming and examines its application on selected farmers' groups in Thailand. The chapter gives special attention to roles played by the government in the initial stage of contract farming. Contract farming has been increasingly seen as a means to assist small growers in gaining market access and reducing price risk, and, as such, it has attracted attention of development agencies and developing countries. The case of Thailand provided insightful results, particularly on long-term scenarios as the country is a pioneer of contract farming in Asia. The study reveals that even for countries with more experience in contract farming, the public sector remains important in providing policy and infrastructure support to foster a favorable environment for investment in agribusiness and in coordinating with concerned parties to raise agricultural productivity. In the long run, as small-scale farmers are able to accumulate production and management skills, thus improving their bargaining position, the farmers' best choice may include noncontract production. The chapter also discussed issues of contract farming, particularly the need for welfare arrangements and special measures to encourage the full participation of small marginal farmers.

Part II of the book has four chapters, which includes the methodology used in the case studies to assess the impacts on socioeconomic welfare and three case studies on contract farming experience in selected Asian countries.

The third chapter by PingSun Leung and Junning Cai describes the methodology used in the ensuing chapters in order to quantitatively assess the effects of contract farming on the performance of the smallholder farmers in several developing nations of Asia. Since the assessment is conducted using nonexperimental field survey, it is necessary to adjust for the potential bias, such as the structure of available information and

the nature of the problem, resulting from self-selection. The study used statistical method to overcome the common problem of selection bias in the survey data. Two popular methods—propensity score matching and switching regression—are used to correct for the potential bias depending on the situation at hand.

The fourth chapter by Junning Cai, Sununtar Setboonsarng, and PingSun Leung, tests the effectiveness of contract farming as a tool to facilitate transformation from subsistence to commercial agriculture, and hence improving farmers' incomes. Using data from a survey of 445 organic rice contract farmers and conventional rice noncontract farmers in Thailand, the chapter adopts profit-frontier analysis and counterfactual analysis to assess the profitability and profit efficiency of farms at different scales of operation. The results show that organic rice contract farming is more profitable than conventional noncontract farming by a significant margin for all scales of operation. In particular, the findings reveal that (i) a combination of contract and organic farming is effective in improving the profitability and efficiency of small-scale organic rice farmers, and (ii) small farms are more profitable and efficient than larger farms. Beyond financial benefits, if the potential environmental benefits (e.g., zero leakage of agrochemicals) and health benefits (e.g., nonexposure to pesticides in organic agriculture) are included, the total economic benefits would be greater.

The fifth chapter by Sununtar Setboonsarng, Adam Stefan, and PingSun Leung looks into the case of contract farming in a transitional economy, i.e., the Lao PDR, characterized by market failure and subsistence production. Using data from a household survey of 332 contract farmers and 253 noncontract farmers, the chapter attempts to empirically assess the potential of contract farming as a development tool to increase small farm incomes and reduce rural poverty. Using the propensity score matching methodology and an endogenous switching regression model to assess the profitability of contract and noncontract rice farms in the Lao PDR, the authors found that (i) contract farmers earn significantly higher profits than noncontract farmers; and (ii) contract farming tends to provide the greatest increase in income to farmers with below-average performance. These findings suggest that contract farming can be an effective private sector-led mechanism to facilitate the transition to commercial agriculture, bringing in foreign direct investment into the rural sector, improving profitability, and raising incomes of small-scale farmers, thereby reducing poverty in rural areas with limited market development.

The sixth chapter by Junning Cai, Luyna Ung, Sununtar Setboonsarng, and PingSun Leung uses the experience of favorable production bases. Based on a survey of rice contract farming for export in Cambodia, the chapter uses simple mean, propensity score matching, and switching regression comparisons to assess the impact of contract farming on farmers' performance. The authors found that (i) farmers with larger family sizes, younger and more educated household heads, less asset value, and those with farm locations closer to the highway are more likely to join the contract; and (ii) contract farming of noncertified organic rice has a positive impact on farmers' profitability. They also suggest that progressive farmers living near the highway tend to join the contract first, but leave contract farming early, while farmers in more remote areas remain under contract. It appears that the sampled former-contract farmers' profitability did not decline after leaving contract farming. This illustrates how contract farming helped subsistence farmers develop into independent commercial farmers. However, since contract farming in this case is not inclusive of the marginal farmers, public sector support is required to lower the transaction costs of working with them.

Part III of this book discusses the necessity for smallholders to comply with certification and/or traceability standards in production systems required in international trade, and it also offers some perspectives of Japanese agribusiness firms on contract farming and public sector roles in expanding contract farming as a development strategy.

The seventh chapter by Daniele Giovannucci and Timothy Purcell discusses the context wherein certification and/or traceability systems have become global trading requirements, and how contract farming can play a role in facilitating compliance. Requirements for levels of quality, packaging, safety, and production process have become more stringent and compliant players are mainly large firms including supermarket retailers that impose their own high-performance standards on their value chains. These developments push developing countries toward industrialized models of farming systems; in order to operate successfully in lucrative national or international markets, smallholders should understand and achieve new levels of standards. This chapter presents options for small farmers, who still comprise the great majority of the world's agricultural producers. Policy solutions will require a commitment to innovative institutional structures that can equitably link international capacity to local needs. A better understanding of and collaboration with value chains via practical structures such as contract farming will help ensure competitiveness and inclusion of small enterprises and farmers.

The eighth chapter by Jun Sakai, Sununtar Setboonsarng, and Lucia Vancura discusses the necessity of traceability systems on agrifood production using two cases studies in Japan. As prevalence of food safety problems increases, establishing a reliable food traceability system could improve consumers' confidence and address the documentation requirements of trade agreements. The case studies on dried shiitake mushrooms and on poultry products, both by smallholder farmers, shed light on the institutional arrangements, hardware and software requirements, costs of operation, roles of the public and private sectors, and the impacts of two food traceability systems in Japan. The studies also show how information and communication technology can help establish an efficient traceability system and improve consumers' confidence in the products. Overall, traceability systems facilitate improved efficiency in the management of the supply chain, allowing quick responses to food safety incidents.

The ninth chapter by Sununtar Setboonsarng discusses the opportunities and constraints of contract farming of green products as perceived by Japanese firms operating in developing countries in Asia and explores the potentials and constraints in their roles of enhancing rural poverty reduction. The study summarizes case studies conducted by the Japan External Trade Organization (JETRO) on Japanese firms and is complemented by a survey of 59 Japanese food trading firms importing food from Cambodia, the People's Republic of China (PRC), the Lao PDR, Thailand, and Viet Nam. The survey was conducted to examine the extent to which contract farming is used to ensure stable supplies that meet the product specifications of Japanese consumers, especially mechanisms to ensure food safety. It also investigates the motivations underlying the firm's country of choice for investment and how the institutional arrangement between contracting firm and contracted farmers can be improved. The findings show that countries like the PRC and Thailand clearly are more advanced in terms of facilitating the adoption of contract farming, while Viet Nam is rapidly catching. The results echoed the findings of other studies in this volume on the need for public sector support in expanding contract farming as a development strategy.

Part IV discusses innovative forms of contract farming as it evolves in the course of practice. This section has two chapters looking into the cases of written and verbal contract farming and social contract farming.

The tenth chapter by Tangon Munjaiton, Junning Cai, Sununtar Setboonsarng, and PingSun Leung discusses the experience of farmers in asparagus contract farming in Thailand; comparing two types of contractual

agreements: verbal and written. Using propensity score matching to assess the impact on profitability between written and verbal contracts through a survey of asparagus farmers, results reveal that the written contract was chosen by smallholder farmers as an avenue to mitigate marketing risks of operating independently, as written contracts require prior membership to a farmers' group to allow pooling of production volume. As farmers under written contracts gain enough experience of the contract farming trade, giving them networks of buyers, technical expertise, and membership to farmers' group, they have a tendency to move out of the written contract, i.e., becoming farmers under verbal agreements, while sustaining the gains generated from a formal written contracting system. Simple mean comparison of profitability shows that written contract farmers earn significantly higher profit than verbal contract farmers. However, the propensity score matching comparison which controls for selectivity bias shows that while profitability is higher among written contract farmers, the differences between the written and verbal contract farmers are not statistically significant.

The eleventh chapter by Tangon Munjaiton, Sununtar Setboonsarng, and PingSun Leung discusses international social contract farming used in banana export from Thailand to Japan. This innovative form of contract farming allows consumers in developed countries to directly contract smallholder farmers in developing countries to produce crops with specific attributes, in this case, organic bananas between a consumers' cooperative in Japan and smallholder farmers in Thailand. The arrangements even include setting aside a percentage of sale proceeds to finance farmers' visits to consumers in Japan which serve as a form of monitoring system. To assess the impacts of this form of contract farming, survey results were analyzed based on a sample of 110 banana farmers in Banlat, Petchburi Province, Thailand; 74 of whom are under contract to grow organic bananas and the remaining 36 are independent nonorganic growers. Using the propensity score matching method to address selectivity bias among farmers, results of data analysis showed that contracting firms have a preference toward farmers with "bigger" farm areas. As contracts prohibit chemical use, farmers are discouraged from crop diversification in the production sites. Hence, total agricultural income can be lower among organic contract farmers, particularly at the initial stages of conversion. Only when markets develop for organic crops are the financial benefits of organic bananas further enhanced.

As this compilation of studies shows through empirical analysis, the economic benefits of contract farming go beyond improved profitability

of contracted farms. Compared to noncontract farmers, farmers under contract often have more education, assets, and land. Contracted farmers also gain assured market and credit access, technical training, and quality inputs and are at reduced risks of price fluctuations and production failures. The provisions from contracting firms significantly augment the scant resources of governments in developing countries to provide research and development, extension services, and other rural development programs. Moreover, in the case of organic farming, environmental issues are also addressed as the practice enhances soil structure and emits less greenhouse gases. As organic farming is intrinsically labor-intensive, it also employs more excess labor in rural areas.

Contract farming has been practiced for decades now in Asia, and we can see in this volume how the arrangement has helped participating farmers and firms and how it can be further enhanced. One recommendation is the provision of some form of social welfare system similar to other forms of contractual employment to be adopted by contracting firms. There is also a need for small producers to receive support to modernize their production practices through information and communication technology, and establish traceability system to help them increase their market reach and access, both locally and internationally.

While governments figure largely in contract farming initiatives, it is essentially a private sector-led initiative. The proliferation of contract farming in developing countries with quality natural resources and abundant rural labor is perceived as a response of agribusiness firms to stringent export markets and increased consumers' awareness on food safety and healthy eating which have raised demands for clean food. Needless to say, success cannot be achieved without the government's policy support that will enable contract farming mechanisms to operate as expected.

As the case studies show, through contract farming arrangements, small farmers in marginal areas have directly benefit from rural development, creating growth that is both inclusive and palpable in rural communities. Contract farming is also evolving and now comes in modified forms to better address the needs and capacities of parties involved, yet its service of linking producers and markets remains unchanged, along with the gains it brings to smallholders, as well as to agribusiness firms and end consumers.

Finally, the authors and editors would like to take this opportunity to acknowledge the generous support of the Asian Development Bank

Institute (ADBI) in Tokyo and the Asian Development Bank (ADB) in Manila which made the chapters in this book possible and their publication as a book.

The authors would also like to thank all those who contributed to this book project, particularly Mario M. Lamberte and Douglas H. Brooks for their valuable comments. The editors also express their utmost gratitude to James Nugent, Director General, Southeast Asia Department, ADB, who provided the foreword for this book and whose support made this publication possible.

The editors also appreciate the tireless support of colleagues at ADB, and Elsbeth E. Gregorio for her management and editorial work on this book project, as well as the many anonymous contributors including farmers, government officials, project managers and consultants, academics, and business people who unselfishly contributed their time and expertise during the field visits and in the course of the research.

PART I

Overview of Contract Farming and Regional Cooperation

1. Global Partnership in Poverty Reduction: Contract Farming and Regional Cooperation¹

Sununtar Setboonsarng



1.1 INTRODUCTION

The Millennium Development Goals, the blueprint for development intervention adopted by member countries of the United Nations, highlights global partnership in development as one of the main goals toward poverty reduction. Among the recent consequences of globalization is the increased coordination of food production. With the majority of the world's rural poor engaging in agriculture, agricultural globalization is arguably the single most important global partnership for poverty alleviation.

In emerging economies in the Greater Mekong Subregion (GMS) such as Cambodia, the Lao People's Democratic Republic (Lao PDR), and Myanmar, over 90% of the poor are smallholders who depend on agriculture for their livelihood. With rapid development of rural transport infrastructure, new market opportunities for higher-value crops are expanding in these countries. In order for the rural poor to successfully participate in a market economy and to benefit from globalization, backward and forward market linkages need to be established. These linkages include the provision of information on market demand, technical support, rural credit, improved farm inputs, product accreditation, and markets for the produce.

Beyond initial linkages to local markets, with market liberalization, the rural poor in these countries must also respond to worldwide competition governed by international trade agreements and food safety standards requirements. Without assistance to cope with the changes brought about through international trade agreements, the poor could be further marginalized from the markets.

While the development of market linkages for farmers is traditionally viewed as a public sector responsibility, the establishment of necessary agroservices for a large number of small, unorganized farmers requires a tremendous amount of public sector resources. Given the limited

¹ First published as Setboonsarng, S. 2008. "Global Partnership in Poverty Reduction: Contract Farming and Regional Cooperation in Cambodia and Lao PDR." ADBI Discussion Paper 89. Tokyo: Asian Development Bank Institute. Available: <http://www.adbi.org/files/dp89.global.partnership.poverty.reduction.pdf>

government and donor resources available, private sector generation of pro-poor growth may be a key to large-scale poverty reduction.

In recent years, in the less developed GMS countries, contract farming² has been expanding rapidly. Contract farming is a contract between a farmer and a purchaser established in advance of the growing season for a specific quantity, quality, and date of delivery of an agricultural output at a price or price formula fixed in advance. The contract provides the farmer with the assured sale of the crop and at times provides for technical assistance, credit services or inputs from the purchaser (Binswanger, Deininger, and Feder 1995). The purchaser³ gets a guaranteed, steady supply of produce. Contract farming may have a global scope, with both positive and negative impacts. Its widespread application in the emerging GMS countries has prompted the need to revisit issues associated with contract farming in the globalized environment.

1.2 EVOLUTION OF CONTRACT FARMING—MARKET AND INSTITUTIONAL FAILURE

Agriculture sectors in developing countries, in particular those found in transitional economies such as the Lao PDR and Cambodia, are characterized by market and institutional failures. Market failure arises from the endemic lack of information on market demand, price, production technology, and credit, all of which stem mainly from low-level infrastructure development. Institutional failure is largely a result of economic transformation from a socialist central control system to a market-driven system. This section reviews the theoretical basis for the emergence of contract farming.

1.2.1 Institutional Failure, Market Failure, and Contract Farming

According to new institutional economics (NIE), institutions evolve to minimize the costs of resource allocation (Williamson 1979). Williamson (1979) also suggests that different governance structures and contracting forms arise depending on the frequency of transactions, the level of

² Contract farming in this study is defined as arrangements whereby development assistance or agriservices are provided to farmer. This could include improved farming practices, provision of extension services, quality control mechanisms, credit, and market for products. Contract farming in this study does not include informal contracts between local traders and farmers without provision of technical assistance and quality improvement. These informal contracts provide only in-kind inputs at the start of the season, and cost of inputs is deducted when the farmer sells outputs to the trader.

³ The terms purchaser, contractor, and firm are used interchangeably in this study, although the majority of purchasers in the context of this study are largely agribusiness firms.

certainty to which transactions are subject, and asset specificity. North (1990) formally defined institutions as “the humanly devised constraints that shape human interaction; they affect the performance of the economy by their effect on the costs of exchange and production.” Or simply put, they are the rules of the game in a society.

Using NIE, Warning and Soo Hoo (2000) emphasize the role of transaction costs and imperfect information in determining the structure of agrarian institutions, including contract farming. Key and Runsten (1999) and Patrick (2004) suggest that contract farming has evolved to ensure the participation of smallholders unable to gain access to spot markets due to market failure in credit, information, factors of production, marketing, and so forth.

Simmons (2002) states that three factors contribute to transaction costs:

- Bounded rationality—differences in information between contracting parties
- Opportunism—either party taking advantage of the other
- Asset specificity—risks associated with protecting “sunk costs” in processing plants, logistical systems, market development, or, for smallholders, the cost of protecting investments in specialized machinery and knowledge (Simmons 2002, citing Dorward 2001)

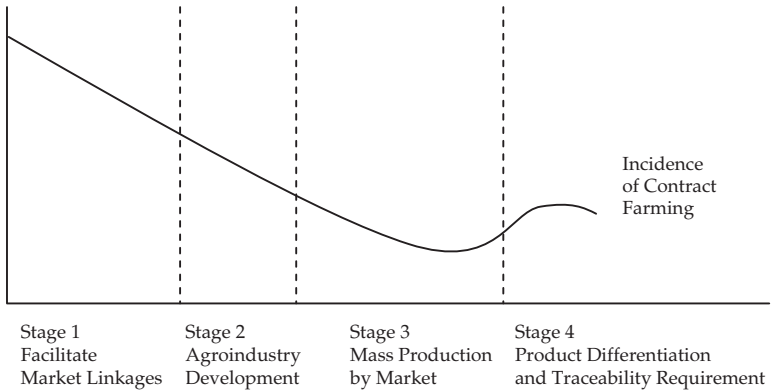
As Simmons (2002) writes, “In the absence of these factors, contract farming may not occur, since buyers could acquire produce in spot markets that would be instantly and perfectly responsive to their demands.” In the case of agricultural products with special attributes that are often difficult to measure, contract farming and vertical integration may lead to better control of inputs, resulting in more uniform product attributes and a reduction in the cost of measuring quality, grading, and sorting of the products (Martinez 2002). To facilitate transactions in environments where spot markets fail to address information and institutional failure, contract farming and vertical integration are increasingly being adopted as a supply chain governance strategy.

1.3 IMPORTANCE OF CONTRACT FARMING IN DIFFERENT STAGES OF MARKET DEVELOPMENT

Based on stylized facts from developing countries across Asia, the importance of contract farming as an institution for facilitating market exchange differs at each stage of market development (Figure 1.1).

Figure 1.1 Stages of Market Development and Contract Farming

Transactions Costs
(Monitoring + Supervision Costs)



Source: Author's depiction.

If contract farming is to be classified based on its main function, it could be summarized as follows:

Stage 1: Transformation from subsistence to commercial agriculture: the main function of contract farming is facilitating transformation from subsistence to commercial farming.

Stage 2: Development of agroindustry and crop diversification: contract farming is essential in the growth and development of the agroprocessing industry.

Stage 3: Mass production and spot market transaction: the market functions well, and the importance of contract farming is relatively limited.

Stage 4: Product differentiation and globalization: contract farming functions as an institution to address market failures associated with product attributes in the globalized market.

1.4 BENEFITS OF CONTRACT FARMING TO FARMERS

Market access. One of the principal motives for smallholders to enter into a contract farming arrangement is the promise of a steady and increased income from having an assured market. Contract farming arrangements serve to link farmers to distant markets where the demand for and price of crops are often more favorable. Market access can also result in the

expansion of cultivated areas. In a banana contract arrangement in Thailand, farmers without contracts in the same area were observed to be cultivating smaller areas since they had limited market opportunity to sell produce. Once farmers entered into contract farming, they doubled their growing areas and brought unused land into production (author's field visit, 2004).

Increased incomes. Contract farming promotes farming of nontraditional crops that are sold for a higher price and may be grown without significant extra effort. Although contract farming is not applicable to all crops in all stages of market development, numerous empirical studies from around the world demonstrate that contract farming can lead to improved income of same-crop-growing without contract. Income generated by organic rice farming in Thailand is 70%–100% higher than conventional farming (Setboonsarng, Leung, and Cai 2006). Glover and Ghee (1992) and Glover and Kusterer (1990) in their studies in Southeast Asia, Latin America, and Africa confirmed that the majority of contract farming efforts appear to contribute to smallholders' welfare by improving income. Such arrangements enable farmers to forecast income levels, which aids in planning of farm production schedule (White 1997).

Reduction in the risk of price fluctuations. Increased income in contract farming is generally accompanied with lowering price risk for farmers. In agriculture, prices can fluctuate drastically from region to region and within a growing season. Smallholders have little access to information and face the risk of losing substantial income if prices fluctuate downward. In contract farming, however, a predetermined price for the crop is generally established during contract negotiations at the onset of the growing season. As a rule, firms typically purchase the crop that falls within specified quality and quantity in accordance with the contract, and farmers are not subjected to incur losses in sales from price fluctuations. Hence, farmers can lower their price risk while gaining market access (Binswanger, Deininger, and Feder 1995; Baumann 2000; Eaton and Shepherd 2001).

Credit and financial intermediation. Lack of access to credit remains a large constraint in improving agricultural productivity. Formal credit markets in rural areas of developing countries seldom exist, and where they do exist, banks are reluctant to lend to smallholders. Even in areas where microfinance institutions exist, these institutions tend to offer loans to microenterprise and not to agriculture production. The production of nontraditional cash crops generally entails greater expense than production of traditional subsistence crops. Firms are in a better position to provide

credit than banks since they usually possess greater ability to monitor and enforce credit and therefore overcome problems caused by financial market imperfections. Additionally, firms may extract the debt that farmers owe from the payment of the procured crop (Key and Runsten 1999). Firms can also lend to farmers in-kind, e.g., seeds and modern inputs (Baumann 2000). In cases where firms do not extend loans to farmers, banks often accept the contracts as collateral (Glover and Ghee 1992). As in Thailand, government policy can also play a role in encouraging such a strategy.

Timely inputs and production markets. In remote areas with limited material inputs and transportation infrastructure, timely access to inputs is a significant problem for smallholders. Lack of nontraditional inputs and production resources such as improved seeds, fertilizers, or tools is a common constraint for productivity improvement of smallholders. Underdeveloped inputs and product markets may make it difficult for firms to obtain the desirable quantity and timely delivery of crops. To achieve projected yields and desired quality, contracting firms frequently undertake measures to ensure that contracted producers have timely access to inputs including seeds and fertilizers, in addition to training support and the monitoring of proper crop husbandry practices (FAO 1999; Baumann 2000; Eaton and Shepherd 2001). While farmers benefit from timely access to inputs and markets, firms benefit from ensured delivery of the quality products. The aid provided to smallholders by agribusiness often includes training and assistance in crop production, soil and water management, bookkeeping of inputs and outputs, and at times even gender-awareness training. More recently, firms have introduced traceability systems into contractual arrangements. The value-added benefits of the skills passed on to farmers continue after agreements have expired. Glover (1987) attests that aside from technology transfer, farmers gain experience of “the system” through contract farming. Farmers can become astute on how markets work, how to manage accounts, and how to run their farm as a business.

Monitoring and labor incentives. It is argued that smallholder contract farming is more efficient than other forms of institutional arrangement for production, as production efficiency depends largely on the work efforts of the laborers. In large farms or plantations where laborers are employed, the cost of supervision is generally high and hired laborers may be motivated to shirk job responsibilities (Eswaran and Kotwal 1985). In small family farms, laborers have the incentive to work conscientiously for the sake of their own family’s well-being (Hayami and Otsuka 1993; Hayami 2003). Booth (1998) and Hayami (2003) reported that although Thailand started canned

pineapple production relatively recently, production had surpassed that of the Philippines, previously the world's leading exporter. Whereas the Thai system is based on contract farming, Philippine production is largely based on the plantation system. In this respect, family-run ventures appear to be equally or more efficient than plantations based on hired labor. It appears that contract farming can evolve to mitigate extensive monitoring and labor supervision costs.

Reduction of production risk for farmers. Contract farming arrangements facilitate risk sharing in the case of production failure due to uncontrollable circumstances including poor weather or disease. Through contractual arrangements, the risk of total income loss due to crop failure can be reduced for farmers. Where production problems are widespread as a result of uncontrollable events, firms will often defer the repayment of production advances until the following season (Eaton and Shepherd 2001). In addition, upon contract authorization, subsidies may be provided to diminish risk during the startup of the new enterprise. Glover and Kusterer (1990) report that for smallholders, whose contracts were subsidized in the early years of their participation, an extension from the contracting firms was important in reducing yield risk.

Introduction of higher-value crops. According to Baumann (2000), small-scale farmers are often reluctant to adopt new technologies and diversify from traditional crops due to risks and costs involved. Through contract farming, firms can provide the support needed for smallholders to shift from subsistence agriculture to market-oriented production (Eaton and Shepherd 2001; Patrick 2004). Since agribusiness firms possess a vested interest in the production of high-value crops, their contractual arrangements often facilitate the introduction of new production techniques and measures that serve to upgrade quality of agricultural commodities (Baumann 2000). Many introduced measures to increase productivity while preparing crops to achieve the high-quality standards of international markets. Manarangsan and Suwanjindar (1992) report that farmers in Thailand contracted to grow palm oil, pineapples, and asparagus gained new technical knowledge from training programs, particularly on crop management of contracting firms, and were closely supervised.

1.5 BENEFITS TO FIRMS AND THE PUBLIC SECTOR

Cost efficiency for firms. Contract farming allows agribusiness firms to improve cost efficiency and minimize risk by avoiding the purchase of land or the hiring of labor (Hayami 2003; Patrick 2004). It also allows

agrofirms to avoid risks involved with agricultural production, including fluctuations in demand and supply, through the procurement of produce from farmers.

Quality consistency. With firms extending technical support and supervision over farming practices, product quality consistency is improved under contract farming. The degree of effectiveness and cost associated with quality monitoring, however, may differ with types of crops. For example, large plantations are suited to banana crops since management tasks are clearly defined, frequently uniform, and do not require many judgment decisions or a great deal of initiative on the part of workers (Key and Runsten 1999). In soybean contract farming in Thailand, acreage cultivated is limited to the farmers' ability to maintain quality levels. In contrast, nontraditional crops such as vegetables for export are unlikely to be successful in a plantation environment, since they are technically more sophisticated and require worker initiative to achieve satisfactory yields and meet quality requirements (Glover and Kusterer 1990; Hayami and Otsuka 1993).

Facilitation of trade standard requirements. One consequence of a globalizing agritrade is the growth of multinational corporations (MNCs) sourcing food from developing countries, where labor cost is low and natural resource endowments are favorable. In order to satisfy stricter food safety, social, and environmental standards; specific consumer demands in importing countries; as well as requirements under international trade agreements, MNCs opt for contract farming arrangements to maintain control over inputs throughout all stages of production and processing. As consumers insist on information related to country of origin, inputs, and food production processes, governments of importing countries increasingly require formal documentation of the food traceability systems of the whole supply chain for imported food. The relative ease of implementing traceability systems through contract farming is another factor increasing its importance within the agriculture sector in both developed and developing countries.

Political acceptability and reduced fiscal burden. Aside from economic aspects, contract farming is more politically acceptable than plantation schemes operated by MNCs (Eaton and Shepherd 2001). Upon economic restructuring, many African governments promoted contract farming as an alternative to private, corporate, and state-owned plantations (Baumann 2000). Beyond its political acceptability, contract farming can also significantly reduce the fiscal burden of promoting agricultural development, particularly in countries that face chronic budget deficits.

These benefits to government include:

- savings on research and development as firms provide technical support,
- effective extension system and traceability system, and
- financial intermediation from credits extended by firms.

1.6 CONCERNS SURROUNDING THE PROMOTION OF CONTRACT FARMING

Although there is a range of benefits in contract farming, it is by no means a panacea to agricultural commercialization and poverty reduction. Several concerns have been raised regarding the desirability of contract farming from a poverty and equity standpoint, foremost of which involves the opportunistic nature of such arrangements as discussed in this section.

Monopsony control. Contract farming as a development tool has been criticized for the exploitative effects of monopsony control, whereby farmers are tied to one purchaser (Grosh 1994). The firms generally possess more information, resources, and organizational ability than small farms. Their strong bargaining position enables them to potentially extract significant rents from smallholders, leaving them only marginally better off.

Little and Watts (1994) reveal cases of farmer vulnerabilities as their bargaining power is reduced due to coercive contractor practices, particularly in cases where firms do not live up to their contractual obligations. Once farmers invest in new crops and production systems to adhere to contractual requirements, financial and time constraints render them unable to easily switch to other types of crops. Lacking alternatives, farmers become dependent upon contractors, and firms are then able to elicit more self-serving contract terms. In addition, the transition from subsistence farming to cash crop production renders households vulnerable to food shortages and nutritional loss from possible crop failures, as many contract farming arrangements are based on monocropping of a nontraditional crop (Key and Runsten 1999).

Burden of labor management. Although contract farming may reduce the cost of labor management for the agribusiness firm, the burden of labor management is in fact transferred to poor farm households (Baumann 2000). Such practice may lead to exploitation since household labor often includes women and children. White's (1997) study of dairy contract farming ventures in West Java showed that in "family-run" dairy farms, women and children provided an estimated 60% of all labor inputs. Yet, as

contractual agreements are often signed by male heads of households, they have control over the proceeds from contract farming.

Contract enforcement. Many developing countries lack the laws and ensuing legal framework to support contractual agreements. Agreements themselves may not be easily enforceable or legally binding. Opportunism on the part of both parties can result. In most developing countries, contract farming arrangements are operated in accordance with traditional values and norms rather than legal agreements (Glover and Gee 1992). In the absence of legally binding contracts, firms can suffer from the effects of extra-contractual sales of outputs or input diversion, as when farmers use inputs supplied by the firm for non-intended purposes (Eaton and Shepherd 2001; TDRI, 1996). Firms can suffer from contract default, particularly when alternative markets develop and competing buyers exist, as farmers fail to repay input credit to the contractor (Coulter et al. 1999). The absence of an effective legal system and the lack of collateral held by small farms can result in considerable risks for agribusiness firms.

Much can be done to mitigate the opportunistic behaviors of both contractual parties. At the local level, farmer organizations and nongovernment organizations (NGOs) can play a pivotal role in protecting farmers' assets by establishing their own systems for quality management, input production (fertilizers), traceability, and, if possible, certification (Audinet and Haralambous 2005). Local government bodies and NGOs can ensure a firm's capacity to offer profitable contracts to farmers prior to the establishment of agreements by checking a contracting firm's financial and managerial capacities.

Bias toward large farms. One criticism of private-led contract farming is that agribusiness firms favor large-scale farmers (Key and Runsten 1996). Agribusiness firms may be motivated to seek contracts with larger farmers to reduce transaction costs and allow for the procurement of more uniform products (Baumann 2000). In this respect, the cost of managing a large number of small farms may indeed influence a firm's decision to establish such relations. Nevertheless, in the context of developing countries, contract farming with small farms has proven successful in some instances. Agribusiness firms may prefer limited land size to ensure easier maintenance and greater quality control over a given crop, as is the case with asparagus and cucumber farming in Thailand. Often, smallholders can produce a high-quality, labor-intensive crop with the appropriate technical support. Nevertheless, although contract farming appears to

involve small farms, such arrangements may exclude the poorest of the poor. Landless peasants and households possessing only limited marginal land tend to be overlooked by firms.

Requirement for increased management skills. Contract farming requires high-level managerial skills on the part of the agribusiness firms. Although the level of supervision is likely to be significantly less than that required for plantation operations, highly skilled management is needed to properly supervise farmers. Poor management and a lack of communication among contractual parties may lead to farmer dissatisfaction and a breakdown in contractual agreements (Eaton and Shepherd 2001; TDRI 1996). By employing local staff or community leaders in managing farmers, contracting firms can improve their conflict resolution management and avoid cultural challenges.

Increased risk. Firms are required to bear increased risk in contract farming. Most contracts stipulate that the firm will purchase all the produce, usually at a price higher than the prevailing market price. The firm may bear the price risk, as well as the risk of crop failure due to poor management or seasonal factors. To ease potential losses, the firm may maintain tight control over management and offer seasonal or annual contracts, so as to exclude unproductive farmers from future contracts (Patrick 2004).

Farmers also face greater production risk as in the case of newly introduced crops as it may take time to adapt to and learn from new growing environments and growing techniques. For example, cashew nuts contract farming in Thailand had initial success but failed after a few years due to an unanticipated pest outbreak associated with nontraditional crop.

Health and environmental implications. In areas where contract farming has been practiced for decades, a holistic assessment is necessary. In situations where contract farming of cash crops (mono-cropping) was undertaken with a heavy reliance on agrochemicals, yields generally increased substantially during the initial period. As a result, household incomes were greatly improved during the first decade, but yields tended to stagnate or decline thereafter, as soil conditions deteriorated due to excessive use of agrochemicals. Many pesticides banned or strictly controlled in the West have been introduced to farmers in developing countries through contract farming. Heavy chemical use has led to serious health conditions for farmers and threatened environmental resources.

1.7 ROLES OF STAKEHOLDERS

Overcoming the negative aspects of contract farming requires action on several fronts and entails the involvement of various stakeholders:

1.7.1 Improving Bargaining Power, Community-level Enforcement, and Contract Management—The Role of Farmers' Group and NGOs

The type and amount of benefits acquired by smallholders depend largely on the strength of their bargaining power. In an effort to reduce transaction costs, firms often prefer to organize farmers into groups or deal with existing farmer organizations. Small farms typically have limited bargaining power, particularly if they possess few assets and scarce alternative income opportunities (Key and Runsten 1999). Farmers' groups can play an important role through the power of group clout (Glover 1987). Farmers' groups appear not only to improve the bargaining power of smallholders, but also serve to lessen some of the criticisms of contract farming.

Farmers' groups can perform the following beneficial functions to improve contract farming ventures (i) facilitate communication between firm and farmer; (ii) provide technical transfer and farmer training; (iii) facilitate credit provision and group guarantee; (iv) achieve economies of scale; (v) aid quality control and assurance; (vi) improve bargaining power and upgrade processes; (vii) form the basis of community empowerment; and (viii) can serve to generate social capital that can contribute to sustainable poverty reduction.

1.7.2 Minimizing Monopsony and Mitigating Opportunistic Behavior—The Role of Government

Contract farming in the first stage of development generally gives monopsony power to firms but it would decline as the number of firms operating in the same area increases. Government-created policies for investment and competition can reduce monopolistic power of firms over farmers. Grosch (1994) asserts that government has substantial latitude to promote contract farming by (i) making the establishment of estate agriculture difficult or impossible; (ii) creating joint ventures with private firms that want to use contracting; (iii) providing complementary infrastructure; (iv) regulating the terms of the contract; and (v) using the police and court systems to help enforce the terms of the contract.

State promotion can ameliorate some of the negative effects associated with opportunistic behavior. Simmons (2002) has identified the role of governments as market regulators to guard against agribusiness abusing its market power. Patrick (2004) asserts that government's role in promoting contract farming may improve conditions at both the macro- and micro-levels. Macro changes would be directed at reducing costs of contracting for all parties. Micro reforms may include giving training, arbitrating disputes, undertaking research, and providing extension services relevant to the expansion of contracting. Training programs for smallholders in literacy, accounting, and cash management may reduce miscommunication in contracts. Experience has shown that a government's ability to plan and execute economic policies can have a significant effect on agrarian transition.

1.7.3 Promoting Sustainable Technologies to Achieve Social and Environmental Objectives—The Role of Corporate Social Responsibility

In recent years, fueled by development of communication technology, an increasing number of consumers are making choices on the basis of social and environmental attributes of the products. In response, firms have started adopting more socially and environmentally responsible ways of production, under the broader ambit of corporate social responsibility (CSR). CSR has played a key role in the growth of investments in pro-poor sustainable technology to mitigate negative health and environmental consequences. These pro-poor and pro-environment technologies include promoting low-external inputs, recycling farm resources, and avoiding premature mechanization or replacement of labor.

1.7.4 Ensuring that Contract Farming Benefits Smallholders Instead of Large Farms—The Importance of Exploiting Comparative Advantage

While it cannot be denied that contract farming has benefited large farms instead of smallholders in several cases, there have also been a number of successes in contract farming with smallholders. Apart from the issue of contract enforcement costs, firms may decide to contract with smallholders when the contracted crop is labor- and knowledge-intensive rather than capital-intensive. This could potentially benefit the poor smallholders since they generally have large families and can provide high-quality labor to meet quality requirements of such crops.

One promising area in this regard would be promoting contract farming for organic agriculture, more so in the case of poorer farmers in marginal areas, since it is organic agriculture rather than conventional methods that can lead to higher yields and better incomes. One study of the Asian Development Bank Institute (ADBI) in Tokyo found that the smaller the farm, the higher the profitability and profit efficiency (Setboonsarng, Leung, and Cai 2006).

1.8 TYPES OF CONTRACT FARMING IN ASIA

Contract farming initiatives in Asia can be classified into two broad categories (i) based on motivations and goals of contractors, and (ii) based on structure and scale of operation.

1.8.1 Based on Motivation and Goals of Contractors

Contract farming schemes have been initiated by a range of drivers in pursuit of different goals or objectives. NGOs and government use contract farming to promote poverty reduction and environmental protection while private agribusiness firms are involved in contract farming for purely commercial reasons. International agribusinesses, on the other hand, adopt contract farming to demonstrate corporate social responsibility in international trade.

Socially-motivated contract farming. The modernization of the agriculture sector has been characterized by the increased use of agrochemicals. At its very worst, agriculture modernization has contributed to an increase in poverty in many rural areas. Many of the grassroots organizations and NGOs turned to contract farming to promote alternative agriculture systems, such as Japan's *teikei* system, capable of protecting the environment and improving the welfare of farmers.

Contract farming to promote alternative or community-supported agriculture (CSA). These alternative agriculture and CSA schemes are predominantly small-scale and mainly target the domestic market. Products are either distributed through consumer cooperatives or sold through farmers' markets. In some instances, the schemes have been initiated by foreign NGOs or fair trade organizations acting as sponsors for contract farming in poor areas of developing countries. For example, the Japan International Volunteer Center has been long involved in promoting contract farming of organic crops as part of its sustainable rural community program in Thailand (Furusawa 2005). With multiple goals of achieving

health and environmental objectives along with maintaining fair distribution of profit among stakeholders involved, the NGO-based contract farming is often limited in scale of operation.

Contract farming promoted by local government. This stream involves a multipartite arrangement initiated by the government, usually in pursuit of broader development or poverty objectives. The arrangement typically involves a government agency, such as that in the Lao People's Democratic Republic (Lao PDR), and a private company jointly participating with farmers.

Purely commercial contract farming. This type was initiated by private agribusiness firms with a purely commercial or business orientation and has become increasingly important for the agriculture sector in Asia, particularly in the People's Republic of China and Thailand. Private-sector-led contract farming is extensively used for the production of nontraditional, high-value agricultural products for export. Interest in promoting private-sector-sponsored contract farming has likewise gained momentum in other Asian countries such as Cambodia, the Lao PDR, and Viet Nam. In the case of such transitional economies, however, the government has played a more central role by facilitating agribusiness firms' access to land and financing. Unlike socially motivated contract farming, contract farming for profit is not limited to crops produced under alternative agriculture systems. While this type can help improve farmers' incomes, its impacts on health and on the environment are open to question.

Contract farming for socially responsible international trade. This stream of contract farming is somewhat of a cross between the two types described previously. With consumer choice increasingly being influenced by food safety, health, social, and environmental concerns, private agribusiness firms in developed countries are not just expected to deliver quality products, they must also produce them in a socially responsible way. Hence, agribusiness firms in developed countries—Japan in particular—are increasingly adopting contract farming of safe food in developing countries to lower production costs as well as to demonstrate CSR. This last stream seems to be the most promising in terms of its potential contribution to large-scale poverty reduction in developing countries.

1.8.2 Based on Structure and Scale of Operation

The choice of structure and scale of operation is dictated by a number of considerations, including: (i) type of crop, (ii) degree of processing, (iii) size of investment, and (iv) relative importance of labor to capital

(Eaton and Shepherd 2001). Based on these considerations, contract farming ventures can opt to follow the large-scale, centralized model or the small-scale, decentralized model.

Large-scale, centralized model. In general, the large-scale, centralized model is preferred for crops subject to stringent processing standards, which require a high level of experience from farmers, entail frequent changes in farm technology, and involve significant long-term investment (Eaton and Shepherd 2001). This model is preferred for crops that require more capital than labor input.

Small-scale, decentralized model. The small-scale, decentralized model is preferred for products/crops that are labor-intensive, such as fresh vegetables, fruits, or horticultural products which do not require a significant degree of processing, and only need to be graded and packaged for resale. Production typically involves minimal short-term investment (Eaton and Shepherd 2001). In developed countries, small-scale, decentralized contract farming is mainly characterized by direct supply contracts between large retailers and smallholders for fresh produce. Due to increasing vertical integration and consolidation in the food industry, direct supply contracts are also becoming more common in developing countries.

In Asia, however, small-scale and decentralized contract farming is still largely characterized by the subcontracting of crop production through intermediaries. Such brokers are the preferred arrangement for contract farming in less developed areas. In this type of arrangement, agribusiness firms purchase crops from intermediaries who, in turn, make their own (typically informal) arrangements with farmers.

1.9 CONTRACT FARMING AND REGIONAL COOPERATION

Initiatives for using contract farming as a key institutional arrangement are under way in the Mekong region. Thailand, for example, has been actively pursuing contract farming as a tool for regional economic cooperation. At the second Summit of the Ayeyawady–Chao Phraya–Mekong Economic Cooperation Strategy (ACMECS)⁴ held in December 2005, Thailand announced that it would allow tariff-free importation of

⁴ ACMECS is a cooperation agreement among Cambodia, the Lao PDR, Myanmar, Thailand, and Viet Nam, which aims to promote balanced development in the Mekong region. The establishment of ACMECS was proposed and initiated by Thai Prime Minister Thaksin Shinawatra in 2003. See www.acmeecs.org for more information.

all approved agricultural products produced under contract farming in ACMECS member countries. As a result, the Summit Declaration included an agreement to “accelerate cooperation on contract farming by setting up as soon as possible joint bilateral working committees to discuss measures to encourage long-term investment, cultivation and cross-border transportation of agricultural products for mutual benefit, including the conclusion of [memorandums of understanding] MOUs on contract farming.”

In keeping with this agreement, the Government of Thailand has signed an MOU with the Government of Myanmar that would provide Thai agribusiness firms with access to 7 million hectares of arable land in Myanmar. The MOU is intended to facilitate investments by selected Thai companies in crops for which there is unmet local demand in Thailand. Thai firms will provide seeds, technology, and equipment for the farmers and will purchase all the products from contract farms.

Table 1.1 2005 Pilot Projects in Contract Farming Firm under ACMECS

Pilot Location	Firms	Land Area	Products	Output Tonnage
Mae Sot–Myawaddy	23	60,200 rai	maize, mung beans, peanuts, castor seeds	28,270 tons
Loei–Xaignabouli	2	210,000 rai	soybeans, peanuts	203,000 tons
Chantaburi–Batdambang	21	43,680 rai	maize, sweet corn, mung beans	46,770 tons

ACMECS = Ayeyawady-Chao Phraya-Mekong Economic Cooperation Strategy.

Note: 1 *rai* is a Thai measurement for 1,600 m².

Source: Ministry of Foreign Affairs Thailand (2005).

Table 1.1 summarizes data on contract farming initiatives registered in the pilot locations as of 2005. It is noted by the National Economic and Social Development Board of Thailand that the registered size of contract farms represents about 1% of the total size of the contract farming operation by Thai firms in other Greater Mekong Subregion (GMS) countries.

The ACMECS initiative makes it possible to use Thai agribusiness firms with successful experiences in contract farming as a mechanism for expanding the scheme in Cambodia, the Lao PDR, and Viet Nam.

1.10 CONCLUSIONS AND RECOMMENDATIONS

The combined effects of globalization, the rising demand for high-value crops, and the development of transport infrastructure in rural areas

has opened up new opportunities for the rural poor to participate in the global marketplace. Still, including the poor in the market is not without challenges. The public sector traditionally has not involved the poor enough in agricultural production and marketing efforts. Until recently, the private sector has made great strides in inclusive initiatives through contract farming. Internationally, contract farming offers many benefits and is receiving increasing support from MNCs.

The literature suggests that contract farming is a promising institutional arrangement to facilitate farmers' access to an array of agricultural services from which they are typically excluded. Contract farming enhances agricultural productivity and efficiency of poor farmers by introducing improved farming practices, provision of inputs, credit, transportation, and extension services; and, most importantly, provision of market access. It also brings investments to rural areas, facilitates cross-border quality control, contributes to employment, and fosters sustainable cooperation within the region.

Though this review focused primarily on GMS transition economies, the potential benefits of contract farming are relevant in the broader context of other developing countries. This review highlights the strong potential uses of contract farming in the following context:

- As a development tool in facilitating the transition from subsistence production to commercial production.
- In facilitating growth of the agroprocessing industry to add value to primary products.
- In facilitating crop diversification through transition from conventional, low-cash crops to high-value crops for niche market in domestic and export markets.
- In fulfilling new stringent trade requirements for export market.

Although it appears that contract farming can potentially lead to large-scale rural poverty reduction, there are several concerns that need to be addressed by the public sector, such as its role on the different stages of development of contract farming.

While contract farming can be effective in introducing new technologies and providing external inputs to farmers, technologies may only provide short-term gains but with long-term health and environmental damage. The public sector must ensure that only sustainable production practices are being introduced through contract farming, particularly to poor farmers who are often illiterate and more prone to inappropriate use of toxic agrochemicals.

Several concerns have been raised regarding the desirability of contract farming from a poverty and equity standpoint. The small economies of scale and the high transaction costs associated with smallholders mean that firms are likely to favor plantation-style contract farming or select farmers with larger land area and higher education for contract production, leaving poorer farmers behind. In addition, contract farming is not appropriate for all types of crops. To have a significant poverty impact, crops produced under contract farming should be labor-intensive rather than input-intensive and should be appropriate for production on small plots of land. While there is a tendency toward bias against small farms, experiences suggest that contract farming of a labor-intensive or high-value crop for niche markets is more pro-poor and should be further promoted.

Many developing countries lack the laws and ensuing legal framework to support contractual agreements, and thus contracts may not be easily enforceable or legally binding. As a result, distrust and the potential for opportunistic behavior exist between firms and farmers, undermining the viability of contracting. In successful examples of contract farming, firms invested extensively to build trust among farmers, often incurring losses in the first year of the contract agreement. Hence, the success of contract farming may be more dependent on sound managerial skills, CSR, and cultural understanding on the part of the firms.

1.10.1 Recommendations

To ensure that contract farming is inclusive of smallholders, production systems in which smallholders have comparative advantages should be promoted. With limited land and excess labor, smallholders typically can only compete effectively in the production of labor-intensive crops. To take further advantage of the relatively less contaminated environment in the GMS and other developing countries, eco-friendly and sustainable production systems, such as organic agriculture should be further explored and supported.

Areas in developing countries where current practices are already low-input or “organic by default” are likely to attract firms interested in producing and marketing safe food. Contract farming of organic food, where the supply gap is substantial in particular, is recommended as a pro-poor development strategy. In this context, the public sector may encourage several firms to operate in the same area to promote competition. As much as possible, the public sector should avoid establishing bureaucratic

requirements for firms or farmers' organizations in order to prevent officials from seeking personal gain from private firms.

The public sector can play an important role in the development of farmers' groups. Local governments may want to develop an information disclosure system on contract farming for farmers as well as firms. Using a "name and shame" strategy based on local values, the opportunistic behaviors could be mitigated. As a long-term development strategy, for legal systems and enforcement capacity to improve, specific laws and regulations should be formulated for contract farming arrangements. Finally, public support for technical, social, and economic research and development, particularly empirical research, will be essential for effective policy formulation.

With regard to regional cooperation, contract farming represents a promising way of creating or promoting market linkages in Asia. More experienced countries in contract farming with well-established market linkages facing land and labor constraints would have it in their interest to partner with countries where such factors or production are readily available. Promoting regional cooperation through contract farming as was the example of the ACMECS initiatives, could be considered in Asia and the Pacific.

The ACMECS initiative is clearly a step in the right direction, and it seems logical for these countries to capitalize on such regional initiatives, including the Asian Development Bank's GMS project, to further build capacities in this area. Apart from reducing poverty, governments of partner countries also benefit from bringing informal border trading into the formal sector through contract farming.

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2. Overview of Contract Farming in Thailand: Lessons Learned¹

Songsak Sriboonchitta and Aree Wiboonpoongse



2.1 INTRODUCTION

During the past decades, Thailand's agriculture has diversified from mainly rice to include various cash crops, including cassava, sugar cane, kenaf, and maize on dry land; and soybean, peanut, and mung bean on both dry and irrigated land. Diversification was facilitated by infrastructure development during the early plans of the National Economic and Social Development Board (NESDB). During the Fourth National Economic and Social Development Plan (1977–1981), policies for value-added exports were promoted and agroindustries grew rapidly, especially in canned fish, pineapples, and tomato products. The sixth plan promoted the integration of farming, processing, and high value-added exports. Compared to other Asian countries, by the early 1990s, Thailand likely had the most extensive experience with contract farming on the widest range of crops (Glover 1992). By the middle of the seventh plan, the export value of agroindustrial products had reached 82,000 million baht and grew to 247,000 million baht by 2003 (Ministry of Agriculture and Cooperatives [MOAC] 2004) and reached 303,069 million baht in 2006. In the fruit and vegetable, and poultry processing sectors where contract production is extensive, growth rates during 2005–2006 maintained high levels—11.1% and 8%, respectively (MOAC 2007).

Contract farming has been instrumental in providing growers access to supply chains with market and price stability, as well as technical assistance. For resource-poor growers, production input and farm investment on credit are often provided by firms. In return, contractors expect delivery of goods in specified quantities, quality, and set prices. Market and price certainty for both parties and integrated farm processing enhance the country's competitiveness via improved quality products and an efficient supply chain. Well-coordinated contract farming systems assist development in less privileged farming sectors.

¹ First published as Sriboonchitta, S. and A. Wiboonpoongse. 2008. "Overview of Contract Farming in Thailand: Lessons Learned." ADBI Discussion Paper 112. Tokyo: Asian Development Bank Institute. Available: <http://www.adbi.org/files/dp112.contract.farming.thailand.pdf>

Contract farming in Thailand is approaching maturity. In the early stage, the government was heavily involved in monitoring, facilitating, and encouraging stakeholders in contractual arrangements. Over time, farmers gained skills, the market evolved, and a more flexible form of contract farming emerged. Today, former contract farmers can negotiate contracts based on best returns and advantages as is the case of potatoes in the North and shrimp in the South where growers can switch between open and contract markets.

2.2 GOVERNMENT POLICY AND IMPLEMENTATIONS

Contract farming had been practiced in some form before the Sixth National Economic and Social Development Plan (1987–1991). Processed food, e.g., canned fish, pineapples, and tomato products, was initially targeted for export markets. Exported canned vegetables in the 1970s mostly carried foreign brand names and contract broiler production started in the early 1980s. Prior to this period, sugar cane and tobacco were produced under contract arrangements. The latter was contracted by the state enterprise.

The sixth plan included guidelines for the development of agroindustries with a goal of promoting value-added exports. To meet the goal, the government augmented guidelines with the so-called “Four-Sector Cooperation Plan to develop agriculture and agroindustry” (4-Sector Plan). Under this plan, agroindustrial firms, farmers, financial institutions (e.g., Bank for Agriculture and Agricultural Cooperatives [BAAC]), and government agencies worked together to improve production systems to reduce price risk and market uncertainty, while farmers improved their technical knowledge and raised production efficiency and the quality of raw materials. In addition to general extension services, the government invested 250 million baht in BAAC (then, 25 Thb = \$1). The capital gain was used as interest compensation for participating farmers (3.5% per annum) and to encourage more farmer participants and to reduce production costs.

During 1987–1993, 12 large projects proposed by 20 private firms were approved, but two did not operate (eucalyptus and integrated hog production) and three ceased production after 1 year (asparagus, ramie, and bamboo for paper pulp) (Office of Agricultural Economics 1993). Nonetheless, Naritoom (2000) reports successful asparagus groups that had contracted with three companies since 1989. The seven remaining projects continued operations after 1993: castor bean, basmati rice, sunflower, wheat, barley, hybrid corn, sorghum, and cashew nuts (Wiboonpongse et al. 1998).

The Office of Agricultural Economics (1991) concludes that the results of the 4-Sector Plan were unsatisfactory, since some of the projects relied heavily on government support (e.g., provision of free seeds for sunflower growers). The plan failure was attributed to lack of management flexibility in light of unforeseen circumstances such as drought, which resulted in low quality and unmarketable produce. Second, farmers needed time to adapt to new crops, which usually involves new technology. When new crops did not provide desirable yields and returns, farmers were discouraged and shifted back to their old crops. Third, as the commodities chosen involved more input and higher risk, extension services were blamed as technical support and delivery systems could not cover all the project areas (MOAC 1994).

Most private contract farming schemes failed in the early 1990s (Baumann 2000). Evaluation of the 4-Sector Plan suggested that contract farming was not for every farmer but an alternative to those who could accept new practices or needed credit. Furthermore, government agencies should not be directly involved between farmers and firms, and contracted businesses should grow without continuous government support (NESDB 1995 in Wiboonpongse et al. 1998).

By the end of the sixth plan in 1991, the NESDB recommended that contract agreements be more effective and beneficial to all parties concerned (Singh 2004). The Subcommittee of the 4-Sector Plan came up with several measures in response to issues regarding fairness and risk reduction to assure cooperation between the government agencies and firms. Measures focused on coordination and risk sharing, such as a “project fund” to provide compensation for production and marketing risk, or group farming and cost sharing among farmers and firms. The last alternative was considered a novel measure and was not implemented.

To raise the probability of success, the subcommittee in 1995 (during the Seventh Plan) consented to support agroindustrial projects (under the 4-Sector Plan) that could reduce production and marketing risks and identify potential target areas and farmers. The proposals were approved based on the highest benefit terms provided to participating farmers by the firms. The subcommittee also improved the 4-Sector Plan and indicated two target commodity groups (i) produce with high-export potential (e.g., high-quality rice, fruits, flowers, and freshwater and coastal fish) and (ii) industrial crops (e.g., vegetables, sunflower, maize, and fast-growing trees). To assure fairness, the government in 1999 took charge of regulating contract compliance using a standard agreement for companies and farmers issued by the Department of Internal Trade (Singh 2004), which is in effect today.

Although there is no explicit mention of contract farming in the Ninth National Plan (2002–2006), government agencies continued to implement it. In 2004, to alleviate a trade issue between the People's Republic of China (PRC) and Thailand, the government compensated farmers if they reduced garlic crops and switched to other crops under contract farming. In addition, the private sector has been encouraged to extend contract schemes to neighboring countries under the Ayeyawady–Chao Phraya–Mekong Economic Cooperation Strategy (ACMECS), a subregional economic cooperation agreement. The scheme enables firms to reduce the seasonality of raw material procurement (Thai Chamber of Commerce 2006).

2.3 MARKET COMPETITION

Thai agricultural marketing systems are generally competitive. In contract farming, a quasi-monopoly has been necessary for success. Japanese cucumber contract farming in the early 1990s appeared to be a monopsony when it had a small and specific market. There was only one company making contracts with farmers, and the nature of contracts and close supervision was similar to other crops new to farmers where the final market required exacting specifications. In recent years, the crop has become more common despite the strict specifications, and quality is maintained by the few companies exporting to Japan.

In high-demand crops such as potatoes and other vegetables, contracted markets are highly competitive. In 1990, there were only two potato processing companies contracting farmers in Northern Thailand. Five years later, there were seven potato processing firms and the competition for contract farmers became intense. In this situation, dissemination of market information was facilitated in the areas, and the prices offered by firms were not significantly different. Farmers were not loyal to any specific company and did not hesitate to switch companies when offered a better deal (Ornberg 1998).

After 20 years of potato production, the supply deal changed as farmers accumulated production and market experience, which enhanced their bargaining power. Meanwhile, increased demand for potato chips put pressure on firms to secure raw materials, and it became easy to obtain potatoes at lower cost with lower quality risk when farmers became skillful in production. Our visits to companies in 2004 revealed that competition for farmers among firms processing the same or different products became fierce in the 1990s before the economic crisis broke out in Asia in 1997.

Contract farming has expanded from Chiang Mai to other provinces in the North. Commodities include poultry and hogs, Japanese rice, basmati rice, organic rice, vegetable seed, corn seed, and various fresh vegetables for frozen and pickled products. The commodities are contracted by large and medium-sized firms owned by multinational companies, joint ventures, or domestic companies. After the 1997 economic crisis, smaller firms left the industry, but competition continued among fewer but larger firms. There were at least three to four companies competing for the same crops. As disclosed by one company, firms need to exercise different tactics to keep their farmers.

Companies either use a price strategy or a quality strategy. This implies high market forces to obtain labor, suitable land, and desirable production environments among industrial firms. For crops that need to be processed within 24 hours (e.g., oil palm, eggplant, and sweet corn), farms' distance to factories is limited to transport under 12 hours, increasing competition within the vicinity. While companies compete for farmers, farmers still seek contracts, and current farmers desire to expand their contracts.

2.4 FORMS OF CONTRACT

The structure of contract farming depends on crops or products, objectives and resources of the contractor, and experience of the farmers (Eaton and Shepherd 2001). In Thailand, four typical contract models can be identified: the centralized model, the nucleus estate model, the intermediary and multipartite model, and the formal model (Figure 2.1).

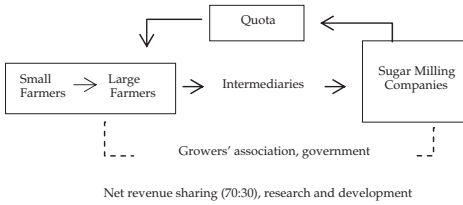
The nucleus estate model is suitable for commodities requiring immediate processing after harvest or high production and management technology that farmers lack. The informal model, which is not as complex, may involve just a few market agents without a written contract. The various arrangements have an impact on pricing and other economic factors in the contract farming systems.

2.5 PRICING

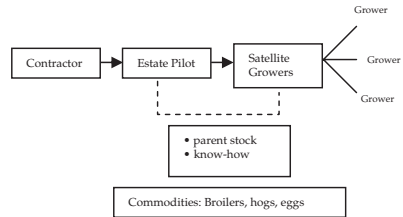
Prices paid for contracted crops are usually lower than market prices. Singh (2004) reveals that most farmers try to sell their produce at markets for a better price, instead of factories where farmers must comply with specific product attributes. This was a common problem for inexperienced factories and is likely to happen in areas where contract farming exists.

Figure 2.1 Examples of Various Types of Contract Arrangements in Thailand

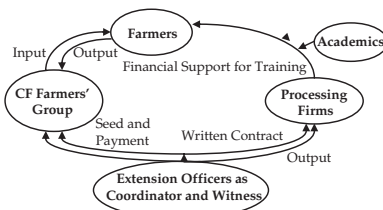
(a) Centralized Model: Sugar Cane



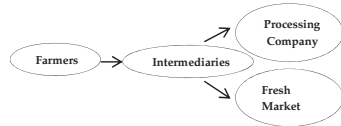
(b) Nucleus Estate Model: Commodities Require High Technology



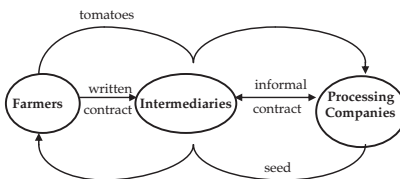
(c) Intermediary and Multipartite Model



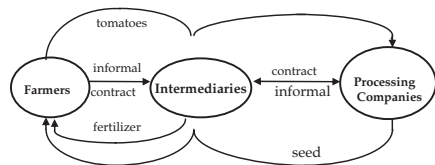
(d) Formal Model



(e) Partly Informal Model



(f) Informal Model



Sources: Wiboonpongse and Sriboonchitta (1995); Eaton and Shepherd (2001).

The problem was solved successfully using various tactics. For crops demanded by both processing firms and fresh food markets—e.g., tomatoes—firms allowed 20% of the crop to be sold in the open fresh food market; then during peak season, when prices declined, factories purchased large volumes of high-quality produce at contracted prices. The economic rationale is the trade-off between risk and return to farmers and stable prices for raw materials.

Prices companies pay to farmers are partly dependent on quality, which is an additional incentive for farmers to deliver high-quality products. For

example, for grade A eggplants, farmers receive 5 baht per kilogram, but the price drops sharply to 1 baht per kilogram for grade B. The quality difference is only the appearance of the skin, even though the other attributes are the same. Crop quality consistency and standards are often the most crucial factors in a contract. However, it is easy for a company to manipulate prices when the market is competitive and prices are volatile (Baumann 2000).

Price stability is essential if firms are to continue projects with their growers and growers are to maintain income stability. This is especially true in the early stages of contract farming. Both companies and governments try to counter market volatility and find ways to stabilize prices for growers. A prescriptive formula is helpful for sharing costs and benefits between growers and processors. Without acceptable and stable prices or credit provision, projects in less developed areas can fail, as exemplified in several cases in Thailand during the 1980s.

Many farmers have voluntarily opted for chemical-free and organic production for health concerns. However, most small organic tangerine growers in Northern Thailand experienced low yields and undesirable appearances, and thus low prices. In contrast to the findings of Wiboonpongse, Sriboonchitta, and Chaovanapoonphol (2006), contract organic (Jasmine) rice farmers in Payao Province enjoyed high yields and prices 30% higher than for ordinary Jasmine rice. Setboonsarng, Leung, and Cai (2007) also reported significantly higher profits per unit of land and higher prices for organic contract farmers than noncontract farmers of conventional rice in Northeastern and Northern Thailand after 1–2 years of organic production.

2.6 EFFECTIVENESS OF CONTRACT FARMING SCHEMES: SUCCESS AND FAILURE

Contract farming projects have had mixed results as discussed below on farmers' responses in the stage of contract farming and the attitudes of growers in Northern Thailand. Several studies in the 1990s reported that most contract farming schemes had failed, particularly in forestry, cashew nuts, and oil palm (Baumann 2000; Falvey 2002; Glover 1992). The first two crops were introduced to farmers who had the least resources in the dry land of the Northeast, while oil palm became a rubber crop alternative in the South. In some cases, early successes in contract forestry (eucalyptus in dry land) were not sustained (Baumann 2000). But with a

global rise in pulp prices, this attracted several large corporations to enter into contracts, for example, CP Foods, Kaset Roong Ruang, Shell, and Siam Cement Group, together with at least 15 joint ventures between Japan and Taipei, China.

Monopolistic conditions have been favorable for contract farming (Glover 1992), whereas competitive environments have not been conducive. However, one exception is vegetable contract farming in Northern Thailand, which has developed within the relatively competitive environment of input markets. Thai farmers are able to acquire input, credit, and buyers on the open market (Baumann 2000; Wiboonpongse et al. 2007; Wiboonpongse and Sriboonchitta 2007). In the case of cashew nuts, a program of the Agricultural Land Reform Office, BAAC, and a private firm, was less successful. This program aimed to cover 175,000 rai (28,000 hectares) in 1990, to be expanded to 300,000 rai over the course of the project, and include more than 31,000 farm households. At first, the project exceeded its target, but was halted by a rapid spread of pests. Poor feasibility analysis and an absence of region-specific research had bearing on the failure, and there were risks that disproportionately affected smallholders (Falvey 2002). This experience showed that research on productivity improvement and cost reduction has to be done for contract farming to be successful.

There are also successful cases. Overall, unlike in other countries, contract farming in Thailand has been implemented and managed differently. One is in terms of the state playing a more central role; contract farming was promoted under the 4-Sector Plan and the Greater Mekong Subregion (GMS) Economic Cooperation Program in Thailand. Since Thailand is an agroexporting country, agribusiness has dominated policy making, and has received substantial incentives and promotion. This has resulted in better overall agricultural growth and development effects through the shift to high-value crops (Burch 1996; Benziger 1996 cited by Singh 2004).

In the western region, sugar cane, baby corn, asparagus, and broiler and hog contracts have proven successful. With baby corn, contracts were made between village intermediaries and farmers, with intermediaries providing farmers with seed, fertilizer, loans, and tractor services. Contracts were made between intermediaries and farmers, but not intermediaries and companies, and involved guaranteed minimum prices that increase with prevailing market price. In the case of asparagus, the main condition of the contract is a guaranteed fixed price based on grades for the whole year. This is the same model used by potato contractors in Chiang Mai and is a successful example of private–government–farmer cooperation (Naritoom 2000).

Thailand is the world's second largest producer of Black Tiger shrimp. During the fifth and sixth national development plans, multinational firms such as Cargill were encouraged to invest in smallholders financed by the BAAC and other banks. Apparently, returns to smallholders were substantial. Given a volatile market, however, small growers preferred operating under contract farming to risk taking. They even rejected a cooperative approach after experiencing poor market prices owing to inadequate quality control. There is also a need to assess risks due to accumulated disease and social impact concerning mangrove deforestation (Falvey 2002).

In the Northeast, the success of exports depends on the provision of irrigation water. Production can be extended during the wet season, and the introduction of dry-season crops and nontraditional crops of high marketability, supported by technical advice under a contract farming scheme has been effective, as in the case of tomatoes supported by BAAC. The expansion of tomato contracting in this region was accompanied by disputes about spoilage, factory shutdowns, and other problems, but they were resolved through mutual-benefit contracts. The case highlights the viability of the government–agribusiness–smallholder relationship as a result of government investment in necessary physical infrastructure, including service and coordination support (Poapongsakorn et al. 1995 cited by Falvey 2002).

In the North, contract farming has been successful in such crops as soybean, baby corn, sweet corn, potatoes, tomatoes, and eggplant, as well as vegetable and maize seed. The number of vegetable processing firms increased from 34 in 1988 to 61 in 1994 and to 78 in 2002. Statistics show that more farmers were entering contract farming beginning in the early 1990s due to various driving forces. Potato contracts received the most development: production in Chiang Mai increased from 600 hectares in 1983 to 4,386 hectares in the 2007–2008 crop years. Contract production has been expanded to six provinces in the North and another three provinces in the Northeast. Total potato production in 2007–2008 reached 125,700 tons, covering over 7,980 hectares.

Farmers contracted companies through their groups. In the first stage of the contract, district agricultural extension officers had an active role in coordination and extension in the San Sai district, the first site of commercial potato production in Thailand. The government has promoted such farmer organizations in contract farming to better position farmers when they deal with companies and for credit collateral and technical

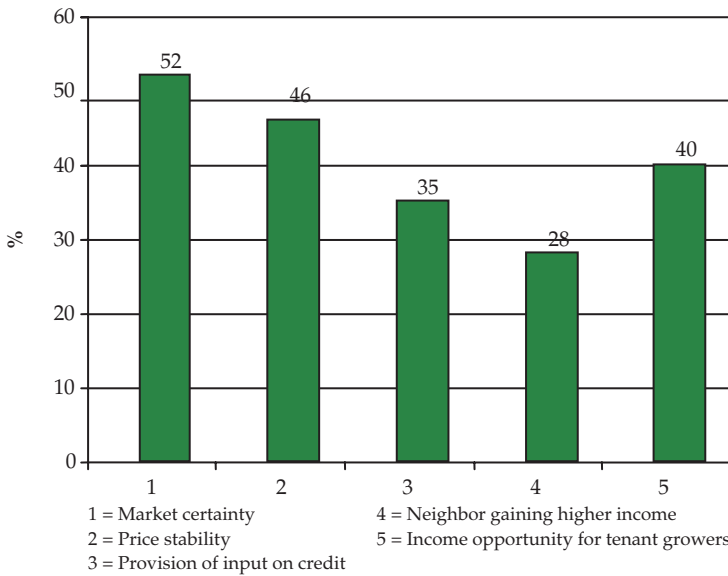
assistance from firms and universities. However, the successful role of the officers in San Sai where land is well irrigated is not replicable in the adjacent district (Mae Rim) due to the local physical and socioeconomic environment. Today, farmers in San Sai have turned to selling their potatoes to intermediaries who gather produce and deliver them to companies. While the intermediaries have contracts with firms, individual farmers prefer taking risks for higher selling prices. However, new potato farmers in other areas were contracted by the companies.

Whether contract farming is a success or failure depends on each case. According to a CP company executive, factoring affecting performance include personnel and other unforeseen events, such as the weather. Public policy and support also play significant roles. Success stories are derived from a “win-win” situation where all key determinants are integrated properly: production technology pre- and postharvest, technology transfer (by the government or private sector), trust building, pricing policy, financial support, and human resource development for both farmers and firms (Poonpiriyasup 2007).

In contract hybrid corn production in the countries of the GMS under the ACMECS, CP reported that Thai growers’ average yield was second (6.25 tons per hectare) to the PRC (6.75 tons per hectare). However, Poonpiriyasup (2007) revealed that Thai growers enjoyed the highest rate of return on investment (ROI) at 94%, whereas the PRC’s ROI was 56%. ROI of contract growers in other Mekong countries (Cambodia, the Lao People’s Democratic Republic, Myanmar, and Viet Nam) averaged 80%.

2.7 FARMERS’ ATTITUDES TOWARD CONTRACT FARMING

Contract farming depends on the satisfaction of both farmers and firms, with profitability a key component. In the initial stage, farmers’ perceptions regarding new crops and their attitudes toward contract farming are important. This section presents results from a survey by Sriboonchitta et al. (1996) in hopes that it may be helpful for agencies attempting contract farming elsewhere. Most of the contract farmers surveyed (78%) grew only one contract crop, while the remainder had two to four different contract crops. The survey revealed primary reasons for farmers’ participation in contract farming as market certainty and price stability, as shown in Figure 2.2.

Figure 2.2 Farmers' Reasons for Participating in Contract Farming

Source: Sriboonchitta et al. (1996).

Other reasons included lack of alternatives and expectation of higher prices. In addition, from the authors' survey in 2004, tenant farmers (40% of respondents) felt that contract farming provided them good opportunities to raise their income as labor was their only resource.

On price agreement, one would expect that most farmers would not be satisfied with the terms. There was a high proportion of dissatisfaction in processing vegetables for the Japanese market (cucumbers, potatoes, and soybean at 67%–75%). Less dissatisfaction was found in the case of maize seed (47.5%) and tomatoes (49%) where products served domestic markets. Furthermore, studies revealed that new crops and new management restrained farmers in continuing the contracts. In the early stage of contract farming, 35% of the respondents felt that new crops were more complicated, while 43% felt the opposite and 22% were indifferent.

Attitudes were affected by production background and experience. Experienced farmers were likely to find production of newly introduced Japanese cucumbers and maize seed relatively easy (Wiboonpongse et al. 1998). Our 1994 survey found the main reason farmers kept contracts (52%) was high return from the crops relative to their other alternatives. Some

farmers (16%) indicated they did so despite not knowing other alternatives, while about 11% maintained contracts because of market certainty.

Firms usually stipulated production quotas on acreage for contract crops to maintain quality. The average sizes of land contracted per household were only about half of what farmers desired (only 40% of the farmers' land). However, the restriction has been relaxed as demand for raw materials has increased and farmers have become more experienced (authors' 2004 survey).

In a contract farming arrangement, firms provided key inputs (i.e., selected seeds and material) to meet preference of their target consumers. Fertilizer and other chemical inputs were strictly controlled to ensure effective results and control residual levels. All inputs were provided on credit through cooperatives, groups, or intermediaries. On average, 80% of the respondents were happy with advance credit as they did not need cash investment.

Most farmers had no information about the price of seed (84%), but knew about fertilizer and chemical prices (68%) since the latter was available in the market. Farmers who found that input prices were higher than market prices (31%) or that inputs were of poor quality (9%) were mostly maize seed farmers who obtained inputs from the land development cooperatives. Despite good government services in the northern areas, the survey reported that 46% of the farmers had not received any services; but about the same proportion received production advice (43%), input supply (7%), and meetings with farmers (3%). On average, 40% of the respondents were satisfied with services provided by the government, including local extension officers.

Farmers also identified the types of information and knowledge most important to them: appropriate application of fertilizer and chemicals (38%), alternative crops with available markets (20%), methods for increasing productivity (17%), appropriate production methods (12%), and others (13%).

2.8 INCOME RISK AND EFFICIENCY

Contract farming provided growers with an assured market, stable income, access to firms' services, ease of credit, and technical knowledge; and it provides agroindustrial firms with an assured supply of good-quality raw material at less fixed investment and low cost. Specific outcomes of contract farming on these aspects are discussed, based on the work of Wipoonpongse et al. (1998) except where indicated otherwise.

In the case of Northern Thailand, in the late 1980s and early 1990s, half of the farmers earned off-farm income before and after starting contract farming. After starting a contract, 74% of the respondents enjoyed a higher household income, while 5% reported reduced incomes. Despite the higher incomes, some farmers (26%) incurred losses due to production and quality risk (all contract crops) and market risk (tomatoes). The major problem was crop damage due to flood and diseases (Sriboonchitta et al. 1996).

Table 2.1 Net Return per Rai from 1984/85 to 1990/91 (baht/rai)

Crop	1984/ 85	1985/ 86	1986/ 87	1987/ 88	1988/ 89	1989/ 90	1990/ 91	Average	CV
Contract potatoes	–	–	–	7,790	5,357	7,268	13,862	8,469	0.438
Non-contract potatoes	3,931	5,346	1,620	15,288	12,847	–	14,395	8,676	0.818
Contract tomatoes	3,435	960	6,874	4,424	8,623	2,910	5,686	4,658	0.556
Non-contract tomatoes	6,120	4,279	4,536	4,381	3,710	6,095	6,706	5,118	0.226

– = missing data, CV = coefficient of variation.

Source: Gedgaew (1993).

A more specific comparison was limited to potatoes and tomatoes, which had dual markets. Table 2.1 shows net returns and variations per rai² of contract and noncontract crops. On average, noncontract crops provided slightly higher incomes (2.5%–10%). Price instability in open markets for potatoes averaged 185% over that of contract prices.

Income discrepancies from the open market reflected price risk and production risk for both crops since the prices were determined by varying market supply and demand. However, contract tomato farmers had higher income variations than their counterparts due to the informality of contract agreements and uncommitted responsibility of the processing firm. Potato prices were more under control, even though they varied. In the end, income variation came mainly from yield risk since prices were guaranteed and made known to the farmers in advance.

Economic efficiency here refers to the combined effects of production and allocated efficiencies in order to minimize unit cost. (Production cost

² 1 rai = 1,600 square meters or 6.25 rai = 1 hectare.

comparisons between contract and noncontract were not available in other studies, so the conclusion should not be overgeneralized.) Unit costs for contract potatoes and tomatoes were lower than those of noncontract farmers. Contract farmers outperformed noncontract farmers. Farmers of both types proved to be profit maximizers under their different production conditions. Sukasem (1992) found that in contract soybean, noncontract soybean, and both contract and noncontract tomatoes and potatoes, farmers applied economic rationales. They allocated their main resources optimally in response to input-output prices.

Contributions from agroprocessing firms in productivity and quality improvement were significant. In one case, a frozen food firm's new soybean variety raised yields from 800 kilograms per rai (1991–1992) to 1,300–1,700 kilograms per rai (1993). For informal contracts like tomatoes, varieties used by farmers in the open market were those once introduced by contract firms. Therefore, fresh tomatoes available in the market were those for processing and consumers could hardly find table tomatoes.

A contract system can boost farmers' production efficiency as was the case for Chiang Mai potato growers, who averaged 43% higher yields than those of noncontract farmers. Technical know-how, followed by education, is a dominant attribute of efficiency, while diseconomy of scale was observed for cultivated areas larger than 1.4 hectares (Wongwiwat et al. 2007).

Both farmers and processing firms have had a long process of learning and adjusting to produce raw materials of a standard quality. Contract farmers have learned to accept criteria for "quality," while farmers in general, who sold their ungraded produce in the open markets, were less familiar with the concept. In rigid contracts such as soybean and Japanese cucumbers, contract farmers realized that their income depended on the quality of grades they produced. 50% of new farmers who received training can deliver high-grade produce. The study revealed that both experienced and new farmers understand the value of quality produce.

Agroprocessing firms have been careful in screening farmers they contract. Diligent and honest farmers receive first priority. Farmers' production of contract crops was limited to ensure quality. Field supervision helped monitor crop quality and provide regular checks of predicted total production. However, the firms through intermediaries, would terminate contracts with farmers who were found to secretly sell his/her produce in the open market or to competitor firms.

2.9 OPPORTUNITIES FOR FARMERS TO GAIN NEW KNOWLEDGE

Farmers under contract for soybean, cucumbers, and maize seed gained new knowledge directly from firms, while potato and tomato farmers had experience and knowledge prior to the contracts. Potato farmers also received technical know-how on areas such as fertilizer and pesticide applications and intensive production scheduling from universities under the firms' support. The knowledge and skills gained from trainings could be applied in cultivation of other crops. Manarungsan and Suwanjindar (1992) report that oil palm, pineapple, and asparagus farmers gained new technical knowledge from input suppliers.

There are trade-offs in contract farming arrangements. Contract farming can lessen farmers' entrepreneurial ability even if they gain management skills. Farmers under contract for prawns (Office of Agricultural Economics 1989) and ducks (Office of Agricultural Economics 1993) expressed that they lost their freedom in farm management. This hindered their knowledge development and decision-making ability. Wiboonpongse et al. (1998) provide ample discussion on the advantages and disadvantages of several contract farming cases in Thailand.

However, the situation has changed. Wiboonpongse and Sriboonchitta (2007) find that potato growers in the oldest production sites have accumulated production know-how and successfully innovated seed storage in place of seed supplied by contract firms. With accumulated marketing knowledge and inputs from local stores and brokers, growers had been cultivating potatoes ahead of season to earn favorable prices at 14 baht per kilogram on the open market; when the normal harvesting date approaches, prices revert to the contract price (8 baht per kilogram). Seed storage technology has allowed growers in many production areas to decide whether to grow with or without contracts.

Table 2.2 illustrates experienced potato growers who are able to enjoy margins twice as high as less experienced (noncontract) growers in similar production environments.

2.10 CONTRIBUTION TO RURAL DEVELOPMENT

Literature in the early 1990s indicated contract farming had not done very well or even failed in Thailand (Glover 1992; also cited by Baumann 2000), presenting an inaccurate picture when considering the relationships between

Table 2.2 Comparison of Contract and Noncontract Potato Production in Chiang Mai Province (2006)

	No. of Growers	Total Cost (baht/rai)	Yield/rai (kg)	Seed Cost (% to total cost)
CF in Chiang Mai	30	16,133.39	2,407.23	33.25
NCF in Chiang Mai	34	18,596.47	2,745.59	14.93

	Price Received (baht/kg)	Total Revenue (baht/rai)	Margin to Growers (baht/rai)	Average Cost (baht/kg)
CF in Chiang Mai	8.22	19,779.43	3,646.04	6.70
NCF in Chiang Mai	9.64	26,462.63	7,866.15	6.77

CF = contract farming (new/less experienced growers), kg = kilogram, NCF = noncontract farming (experienced growers).

Note: Area is expressed in rai (6.25 rai = 1 hectare), income in baht per year (40 ThB = \$1).

Source: Wiboonpongse et al. (2007).

specific company contracts and farmers or groups. Farmers seek terms that they perceived are favorable for them. In a broader sense, contract farming in Thailand, especially in the North, had been increasing prior to the economic crisis of 1997. The trend continued after the economic recovery, as confirmed by expansion of agroindustrial firms and production areas.

Contract farming has been a key element of the Thai government's development plan, reflecting a strategy of "private-led integrated agricultural development" (Glover 1992, in Singh 2004; Wiboonpongse et al. 1998). However, Siamwalla (1996) stated that in the past, the government has relied too much on the private sector to provide new technology through contract farming. This was successful in some cases, but not all. Regardless, the private sector in Thailand has played a significant if not leading role, especially when interacting with farmers (e.g., the use of fertilizers, seed, and chemicals) due to the profit motives of input suppliers and contractors. The private sector is also enabled by government support through the latter's facilitation and guidance for private sector on the implementation of technological transfer for fair business, as it had successfully done with potato contracts. Universities and research centers, especially the National Biotechnology Center (BIOTEC) and Thailand Research Fund (TRF), often contribute basic knowledge for the private sector's research and development. Currently, policies of BIOTEC and TRF encompass public-private research collaboration in order to answer the needs of business.

Contracts can be unfair; and hence may be unpopular for rural development. However, when firms have to compete for limited resources (e.g., contract farmers of selected crops and land), growers can be better off. Moreover, there is no indication that the poorest farmers are being excluded, despite opinions to the contrary. Wiboonpongse and Sriboonchitta (1995) found that the farmers operating under contracts were generally smaller than those not under contract. Their growing area was about half the farm size of those in the Upper North region (3.74–4.8 rai for contract farming and 4.7–5.82 rai for noncontract farming). The average size of cultivated land for contract crops is usually limited for quality control. Potato contracts are an exception (Wongwiwat et al. 2007), possibly because potato production is established and commonplace.

In annual crops like vegetables, firms value growers' diligence, hard work, and honesty. Tenant farmers have an equal chance to obtain the same quota, provided they possess sufficient labor and crop experience. The situation can differ in forestry and livestock (broilers and hogs), where land and capital investment in animals is substantially higher.

As No.14 on the list of the world's food exporting countries (Food and Agriculture Organization 2005), Thailand is a leading net food exporter in Asia next to the PRC. Safety and environmental issues of food consumption in the European Union, Japan, and the United States require products to conform to standards such as ISO 14000, Codex Alimentarius standards, and, in general, Hazard Analysis and Critical Control Points. To meet these standards and be competitive, Thailand must adopt cost-effective production and management along the whole supply chain. Sriwichailamphan (2007) reports that contract growers of pineapple, broilers, and shrimp have adopted good agricultural practices or good animal husbandry practice (also Code of Conduct for shrimp) due to contract farming advice received from contracting companies. Agriculture export standards were most likely taken seriously and adopted when compared to other factors (farmers' environmental awareness, animal survival rate, or pressure from the importing countries).

2.11 WELFARE: THE MISSING DIMENSION IN CONTRACT FARMING

Farmers in developing countries belong to the informal labor sector, by definition of the International Labour Organization. In most countries, social welfare schemes are not extended to farmers (only 20% of informal labor around the globe has adequate social welfare). In Thailand, it is only

recently that Thai citizens have received very modest social or public health insurance. As for the social welfare policy, the Thai government targeted only 0.3 million informal labor workers in the agriculture sector for coverage in 2006. In Northern Thailand, 86% of the farmers reported belonging to least one of these schemes. None of the contract farmers in Thailand and elsewhere receive welfare benefits from formal contract firms. Interviews with the management of international firms confirmed that there was no provision of health insurance in the contract.

As contract farming has been expanding in Thailand and extending into new areas in the Greater Mekong Subregion, it is imperative to consider the welfare issue in addition to fair trade and market access aspects. This is especially recommended for projects under development agencies such as the Asian Development Bank and those for regional economic cooperation (e.g., ACMECS).

2.12 CONCLUSION: LESSONS LEARNED

This section summarizes lessons drawn from the authors' reviews as they relate to this chapter. The conclusions are subject to the different results of various case studies, which are influenced by specific environments. However, general directions one may consider when implementing contract farming in particular settings can reasonably be stated as follows:

On contract terms: At the initial stage of contract farming, it is necessary that both contractors and growers have a clear understanding of the concept and roles they play in an agreement. Rigid contracts are untenable, as farmers do not fully understand concepts, standards of quality, or loss due to late or untimely delivery.

The rigidity of contract terms, which is for fairness to both parties, does not apply to all types of commodities; it depends on local settings. Policies should be directed toward encouraging competition among firms for growers.

For annual crops, contract farming in more developed areas (as shown in projects in the North of Thailand) appears to be effective for linking smallholders to the market. Farmer selection is unrelated to land size. Tenant farmers have an equal chance to join the project.

Farmers need time to adapt to technology and new habits. Contract crops usually require precise working schedules and intensive management. Farmers may not obtain desirable returns in the first year. Contract

agreements designed to spread risks among parties are favored by growers, as in the case of frozen vegetable crops. Yield and quality risk may discourage farmers' continuation of contracts. Minimum returns with intensive and close supervision by firms to avoid crop failure can be incentives.

Price stabilization can help alleviate income risk; however, firms' quasi-monopolistic power could dampen productivity. This role could be better if firms would allow for more competitive pricing in the contracts.

Farmers need information on risk management so they can allocate risk between contract and noncontract cultivation. Innovation (e.g., cold storage for seed) allows farmers to cultivate outside the contract even for the same firms and gain high prices for early harvest. In this case, contracts are no longer the best choice, as shown in the case of potato growers in some cities.

On the role of governments: The public sector has a role to play in technological and institutional development. The government should plan incentives they can manage. Universities, with the support of firms and local officials, can provide regular training in the early stages.

Although agribusiness companies took the lead in contract farming, government policies have provided a favorable environment for domestic and foreign investment in terms of taxation and financing, and the 4-Sector Plan. For example, the success of tomato contracts in less developed areas (Northeast) was due to irrigation and infrastructure improvement, understanding by farmers, efficient coordination, transparency, and timely supervision.

Commitment from local officials is a key element of success in the early stages of contract farming. There should be a nonfinancial incentive system to encourage officials' involvement.

With rising land prices and a competitive global market, firms need to minimize costs for given quality. Competition has led to competitive prices for potatoes, soybean, and eggplant. There is a need for governments to support biotechnology research on quality, efficiency improvement, and cost reduction. Domestic firms should also conduct adaptive research for specific localities.

Contract farming can be promising for agroindustry development. The quality of farm produce can be rapidly improved through contract farming

to meet global market standards. This will require thorough effort from local agencies. It is also important to control exploitation of farmers by private firms.

Contract farming is a commercial activity, and this may explain why there was nothing in the reviewed literature that dealt with growers' welfare or health issues. Therefore, governments and contracting companies have a role to play in providing arrangements that consider liability and health aspects of participating farmers.

Thailand's experience reveals that contract farming has been a successful means for the majority of poor farmers to participate in both local and international markets. It also offers farmers the chance to further increase their economic capacity by contracting in an open market, particularly before normal harvest season.

ACKNOWLEDGMENTS

The chapter has significantly benefited from authors' field studies until 2007 which complemented literature review. The authors wish to acknowledge Puttawan Khunthonthong and Woralak Wongwiwat for their excellent assistance throughout the project, and to anonymous reviewers and editors who gave their detailed attention for the significant refinement of this chapter.

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PART II

Contract Farming Experience in Selected Asian Countries

3. Methodology and Empirical Methods to Mitigate Selection Bias

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3.1 INTRODUCTION

Market access is one major barrier hindering agricultural development, especially for farmers with relatively small landholdings and hence small scale production. More recently, new market requirements on food safety standards and social and environmental sustainability have further excluded small producers from the market. As a strategy for inclusive development, contract farming has been utilized as a possible solution to provide market access (among other benefits, such as technology, certification, and/or credit access) to smallholder farmers. While there are many qualitative case studies alluding to the pros and cons of contract farming as a development tool, very few quantitative assessments have been conducted to date.

The purpose of this chapter is to provide a description of the methodology used in the subsequent chapters in assessing quantitatively the effects of contract farming on the performance of smallholder farmers.

3.2 THE CONCEPTUAL FRAMEWORK

The general framework we employed to quantitatively assess the effect of contract farming falls in the realm of casual analysis of treatment effects and specifically on the estimation of average treatment effects from observational data. Estimating the causal effects using observational data has become very popular due to the great advancements in methodologies simultaneously by both statisticians (e.g., Rosenbaum and Rubin 1983) and econometricians (e.g., Heckman 1979) in the past two decades. It is now widely applied in fields ranging from health and medical sciences (Greenland 2000) to social sciences in general (Sobel 2000), such as evaluation of economic and social policies (Dolton 2002), corporate strategic management (Hamilton and Nickerson 2003), and finance (Li and Prabhala 2007). The literature in this area is vast and rapidly expanding.

In our case, *treatment* refers to whether or not a farmer would choose or be chosen by another party to operate under contract. The effects that we are interested in discerning are indicators on farm performance (referred to as

outcome variables in the literature), such as profit, income, or productivity. Ideally, if we can subject each farm under each condition, i.e., under contract and with no contract, we could assess the effects of contract farming by averaging the differences in the outcome variable of all farms under investigation. However, each farm can only operate under one specific condition at any one time and thus this method is not at all possible.

On the other hand, if we can conduct controlled experiments, we can *randomly* select two groups of farmers and subject one group to contract farming (the treatment group) and the other to noncontract farming (the control group) under the same conditions; then, we can assess the effects of contract farming by comparing their performance. Unfortunately, like most social and economic experiments, this powerful randomization process is infeasible due to its prohibitive cost and may even be unethical at times (Winship and Morgan 1999; Gibson-Davis and Foster 2006).

For example, in our situation, it would be unethical and possibly illegal to coerce farmers to accept a contractual arrangement if he/she is unwilling to do so and vice versa. Another possibility to assess the effects of contract farming is to use longitudinal data, if available, whereby we can use the same farmer as their own control by comparing their performance under contract to their performance without contract at two different time periods. This could be an effective way to assess the effects of contract farming if we can adjust for any period-specific effects on the outcome variables. It should be noted that this strategy, however, would not allow us to detect the effect of contract farming on the farms that have not changed their contractual arrangements. In other words, we would only be able to measure the effects on the treated, the farms under contract.

We will elaborate on this further in a more formal mathematical exposition later. Unfortunately, data available for this study are cross-sectional sample observations of the performance of contract farmers and noncontract farmers, which do not allow us to use either of the above two methods. In fact, this type of data is generally known as *observational data* and their analysis is referred to as *observational study*. Observational data refer to data that are not generated by randomized experiments such as surveys (in our case), censuses and routinely collected public records. As defined by Cochran (1965), “observational study is an empirical investigation in which the objective is to elucidate cause-and-effect relationships ... [wherein] it is not feasible to use controlled experimentation, in the sense of being able to impose the procedures or treatments whose effects it is desired to discover, or to assign subjects at random to different procedures.”

With only cross-sectional data, a naive way to assess the effects of contract farming is to directly compare the average performance of contract farmers and noncontract farmers in the sample. However, as contract farmers may differ systematically from noncontract farmers, the difference in their performance may reflect their intrinsic differences but not the true effects of contract farming. These confounding effects, as commonly occurred in observational studies, would make causal inference about the effects of contract farming equivocal. For example, if there is a reason to believe that more progressive and younger farmers would self-select themselves to enter a contractual arrangement and these farmers are generally considered to perform better, the estimated effects of contract farming would suffer from what is known as *selection bias*. In other words, failure to account for treatment selection biases may lead to biased estimation of the true treatment effects.

3.2.1 A Mathematical Description of Selection Bias

We will now turn to a more formal mathematical exposition of the selection bias described above in order to provide the foundation for the various estimation procedures to assess the treatment effects discussed in the subsequent sections. We will follow the now widely accepted *counterfactual framework* of modeling causal effects of observational data. The mathematical description below follows closely that of Winship and Morgan (1999) and Woodridge (2002).

Let y_1 denote the observed outcome (profit or productivity) under contract (treatment) and y_0 denote the observed outcome without contract (control). The key assumption of the counterfactual framework is that even though a farmer cannot be under contract and without contract at the same time, i.e., we cannot observe both y_0 and y_1 for a particular farm, it has a potential outcome under each state. In other words, each contract farmer has an observed outcome under contract farming and an unobservable counterfactual outcome under the no contract arrangement. Similarly, each noncontract farmer has an observed outcome under the no contract arrangement and an unobservable counterfactual outcome under contract farming. Under the counterfactual framework, the causal effect of contract farming on each farm's outcome is simply the difference between the two potential outcomes under contract and without contract. This difference for farm i can be expressed as $y_{1i} - y_{0i}$. It should be noted that even though y_{1i} and y_{0i} are defined in theory, they cannot be observed simultaneously and thus we cannot directly calculate the individual causal effect for each farm. If we further let t be a binary treatment indicator where

$t = 1$ denotes the farm is under contract and $t = 0$ if the farm is without contract, the observed outcome y can be expressed as:

$$y = (1 - t) y_0 + t y_1 = y_0 + t (y_1 - y_0) \quad (1)$$

Thus, for farm i , if it is under contract (i.e., $t = 1$), then $y_i = y_{1i}$ and if it is not under contract (i.e., $t = 0$), then $y_i = y_{0i}$. It is now obvious that observed y_i for any farm does not have sufficient information to identify the individual farm-level causal effect of contract farming as we cannot observe each farm under contract and without contract at the same time. Indeed, this can be seen as a case of missing data. It should be mentioned that the above definition of the causal effect of contract farming hinges on a very crucial assumption that farm i 's choice to operate under contract farming would only affect the outcome of farm i . This would rule out possible general equilibrium effects whereby the contractual choice of one farm would affect the outcome of other farms. This assumption is known as the stable unit treatment value assumption (SUTVA) in the literature.

While we cannot directly calculate the individual farm-level effect, the literature has focused on the calculation of the average treatment effect (ATE) defined as:

$$ATE = E (y_1 - y_0) \quad (2)$$

We can further decompose ATE into two average effects—in our case, the average effect of contract farming on contract farmers (ATE_1) and the average effect of contract farming on noncontract farmers (ATE_0)—as follows:

$$ATE_1 = E (y_1 - y_0 / t = 1) = E (y_1 / t = 1) - E (y_0 / t = 1) \quad (3)$$

and

$$ATE_0 = E (y_1 - y_0 / t = 0) = E (y_1 / t = 0) - E (y_0 / t = 0) \quad (4)$$

Clearly, $E (y_0 / t = 1)$ and $E (y_1 / t = 0)$ cannot be calculated as they are not observed. $E (y_0 / t = 1)$ is the counterfactual outcome that contract farmers would have experienced on average, had they not chosen to enter a contractual arrangement. Conversely, $E (y_1 / t = 0)$ is the counterfactual outcome that noncontract farmers would have experienced, on average, had they entered a contractual arrangement. If we can assume that $E (y_1 / t = 0) = E (y_1 / t = 1)$ and $E (y_0 / t = 1) = E (y_0 / t = 0)$, then an estimator of ATE based on the observable difference, $E (y_1 / t = 1) - E (y_0 / t = 0)$, derived from a sample

can be shown to be a consistent estimate of the true average treatment effect in the population. This assumption requires that the average counterfactual outcome of contract farmers under a no contract regime is the same as the average observed outcome of the noncontract farmers.

Similarly, the average counterfactual outcome of the noncontract farmers under a contract regime is assumed to be the same as the average observed outcome of the contract farmers. Suppose the treatment indicator t , which can be viewed as an indicator representing the mechanism of treatment assignment, is uncorrelated with the potential outcomes, y_1 and y_0 , then, $E(y_1 / t = 0) = E(y_1 / t = 1) = E(y_1)$ and $E(y_0 / t = 1) = E(y_0 / t = 0) = E(y_0)$. This assumption can obviously be satisfied if the treatment assignment is random as in controlled experiments. However, most of so-called “natural” experiments or quasi-experiments which generated the observational data as in our study are seldom random. In other words, the treatment assignment mechanism is not random and thus is most likely correlated with the outcome variables. In our case, farmers may have self-selected themselves into contract farming or been selected by some agricultural institutions such as agroprocessing firms, government agencies, and nongovernment organizations to participate in their contractual schemes. Consequently, the above estimator of ATE [$E(y_1 / t = 1) - E(y_0 / t = 0)$] is generally biased and inconsistent.

The focus of the proposed remedies in eliminating this potential bias have been (i) to attain a better understanding of the data generation process or the treatment selection mechanism, i.e., how farmers decide on their contractual choice in our case; (ii) to ensure comparability between contract (treatment) and noncontract (control) farms so that difference in outcome can be comfortably attributed only to contractual choice; and (iii) to simulate “randomization” (or create counterfactuals) using information from observational data.

Winship and Morgan (1999) have further decomposed the ATE estimator [$E(y_1 / t = 1) - E(y_0 / t = 0)$], which they referred to as the standard estimator, into three components as follows:¹

$$\begin{aligned} & E(y_1 / t = 1) - E(y_0 / t = 0) \\ & = \text{ATE} + [E(y_0 / t = 1) - E(y_0 / t = 0)] + (1 - \pi) [\text{ATE}_1 - \text{ATE}_0] \end{aligned} \quad (5)$$

¹ Readers are referred to Winship and Morgan (1999) for a more elaborate derivation of this decomposition. The aim here is that the discussion of these decomposed components provides some additional insights into the possible sources of bias.

where π is the proportion of the population that would be assigned or self-assign to treatment. This decomposition nicely separates out the two possible sources of bias in this estimator in the second and third terms of the right-hand side in equation (5) above. The second term $[E(y_0 / t = 1) - E(y_0 / t = 0)]$ provides the baseline difference between the contract farmers and noncontract farmers under the no contract regime. The third term $(1 - \pi) [ATE_1 - ATE_0]$ provides the differential effect of contract farming on contract farmers and noncontract farmers.

For example, suppose contract farmers turned out to be more profitable than noncontract farmers based on the standard estimator of ATE. The above decomposition provides three possible explanations why this is so. First, joining the contract scheme may, in fact, enhance farm profitability as measured by ATE. Second, farms that have entered a contractual arrangement might have been better or more profitable farms to start with. This bias, if it exists, is measured by the baseline difference $[E(y_0 / t = 1) - E(y_0 / t = 0)]$. Third, the impacts of contract farming on farmers may be different. According to equations (3) and (4), ATE_1 and ATE_0 represent the impact of contract farming on the actual contract farms and the actual noncontract farms, respectively. Thus, the third term on the right-hand side of equation (5) measures the difference of the impacts of contract farming on these two groups of farms, which is another source of potential bias. The methods we discuss later are attempts to eliminate these two sources of potential bias.

3.2.2 Treatment Selection Mechanism

As can be seen from the above discussion, the crux of the issue lies in the underlying treatment selection or assignment mechanism. Thus, it is imperative to pursue a deeper understanding of this underlying process. Following Winship and Morgan (1999), we can express the two potential outcomes as deviations from their means: $y_{1i} = E(y_1) + u_{1i}$ and $y_{0i} = E(y_0) + u_{0i}$. Substituting these into equation (1) yields the following:

$$\begin{aligned} y_i &= E(y_0) + t_i E(y_1 - y_0) + u_{0i} + t_i (u_{1i} - u_{0i}) \\ &= E(y_0) + t_i ATE + u_i \end{aligned} \quad (6)$$

where $u_i = u_{0i} + t_i (u_{1i} - u_{0i})$.

As alluded to by Winship and Morgan, equation (6) provides another way of looking at the selection bias problem in the sense that the estimated

ATE (coefficient in front of t_i) from an ordinary least squares estimation of equation (6) would be consistent if t_i and u_i are not correlated.

We now turn to a more formal description of the selection mechanism. A contract selection or assignment equation can be specified as:

$$t_i^* = \gamma Z_i + v_i \quad (7)$$

where t_i^* is an unobserved latent continuous response variable that reflects the farmer's contract choice, i.e., farmer i would join the contract ($t_i = 1$) if $t_i^* > 0$ or stay outside the contract ($t_i = 0$) if $t_i^* \leq 0$. Z_i is a vector of farm characteristics that affect farmers' decision of joining the contract; γ is a vector of parameters subject to estimation; and v_i is a random error term that captures the unobserved factors affecting the selection or assignment mechanism.

Now we can investigate the relationship between t_i and u_i in equation (6) through the selection equation (7). Following Winship and Morgan (1999), we can discern two specific cases some authors refer to in the literature as "selection on the observables" and "selection on the unobservables." The first case refers to the situation when Z_i and u_i are correlated, but u_i and v_i are uncorrelated. This assumption is the so called "ignorability of treatment" assumption in the literature. In that case, the farmer's choice to operate under a contract arrangement is *only* a function of the "observed" Z_i . In other words, t_i is a deterministic function of Z_i . On the other hand, if u_i and v_i are correlated, the farmer's contractual choice will be determined by both the observed Z_i and the unobserved v_i . This is the case of "selection on the unobservables" that assumes "nonignorability of treatment."

In this study, we will employ two popular methods to eliminate these two types of selection bias: the propensity score matching method that assumes "selection on observables" and an endogenous switching regression model that assumes "nonignorability of treatment," i.e., that selection is a function of both observables and unobservables. Clearly, it is easier to implement methods to eliminate the bias due to selection on the observables than the bias due to selection on the unobservables. In fact, this is probably why the propensity score matching method has become so popular recently.

3.3 THE PROPENSITY SCORE MATCHING METHOD

The basic idea of matching is to select a member from the control group (noncontract farmers) which has similar pretreatment characteristics as a member from the treatment group (contract farmers) so that their difference in outcome can be attributed to the treatment (contract) and not the pre-treatment characteristics. These pretreatment characteristics are the observables Z_i , defined above. As mentioned above, propensity score matching method assumes that selection is done only on the observables and thus t_i is a deterministic function of Z_i . Under this assumption, the propensity score matching method in essence is simulating a randomized experiment.² In other words, even though we cannot simultaneously observe a farm both under contract and without contract, we can choose a noncontract farm with very similar observed pretreatment characteristics as the contract farm to create the counterfactual. Of course, this simulated randomization process would not be valid if there are some unobserved pretreatment characteristics that would affect the farmer's contractual decision and the resulting outcome. Randomization essentially balances both the observed and unobserved pretreatment characteristics, and thus, if the unobservables cannot be ignored, matching only on the observables would no longer approximate a randomized experiment.

Obviously, matching on several pretreatment characteristics using the traditional distant metric matching method can be difficult when there are many of them. Propensity score matching essentially reduces the multidimensional matching problem into a single dimension score, the propensity score, which is simply the probability (Pr) of treatment given the observed pretreatment characteristics, i.e., $Pr(t_i = 1 / Z_i)$. This probability is usually estimated using a logit or probit model or classification trees. Rosenbaum and Rubin (1983) have shown that matching using the propensity scores is effective in the sense that there is nothing to gain by a more refined match using the observables Z_i when compared to the single dimension propensity scores, which are a function of Z_i . In other words, the propensity score, or the probability of joining the contract, contains all the necessary information to create a balanced comparison between the treatment (contract) and control (noncontract) groups. The treatment effect for a contract farm can now be estimated as the outcome (profit) of this contract farm minus the outcome of a noncontract farm with equal probability of joining the contract, i.e., equal propensity score.³

² A formal proof can be found in Rosenbaum and Rubin (1983).

³ In practice, it would seldom be possible to find a noncontract farm with an exactly equal propensity score and several matching techniques are employed to circumvent this problem. These matching techniques are discussed later in the section.

Following Caliendo and Kopeinig (2005), the basic steps in implementing propensity score matching (PSM) can be outlined as follows:⁴

- (i) estimate propensity score,
- (ii) choose matching algorithm,
- (iii) check overlap/common support,
- (iv) check matching quality, and
- (v) estimate treatment effect.

The first step of the PSM approach is to estimate farmers' propensity scores based on their basic characteristics (i.e., characteristics that are not affected by the choice of contract). As mentioned previously, the estimation normally proceeds using a logit or probit model. The propensity score of each farmer is simply the predicted value of $P(t_i = 1 / Z_i)$, which measures the tendency in joining the contract.

The magnitude of a propensity score is in the range between 0 and 1; the larger the score, the more likely that the farmer would join the contract. It is important *not* to include in the set of covariates Z any variable that is affected by the treatment. They should strictly be pretreatment characteristics. For example, the sex of the farmer is a suitable pretreatment variable as it would not be altered after the farmer joins the contract. This variable would influence simultaneously the contractual choice and the outcome variable. On the other hand, price of seed may not be a legitimate covariate as this may change after the farmer joins the contract, as is normally the case. An important point to note here is that the main purpose is not to predict the contractual decision perfectly but to ensure that the estimated model adequately balances the covariates. In fact, if the model predicts the propensity scores very accurately, meaning that most of the predicted scores for the contract farms are close to 1 and the noncontract farms are close to 0, it would be difficult to find a noncontract farm with a similar propensity score as the contract farm. In other words, we will need to have some common support or overlap of propensity scores between the contract and noncontract farmers. We will elaborate on this further in the third step below.

In actual practice, however, it is not easy to strike a balance between having many covariates to minimize the bias and yet not including too many covariates whereby no common support can be located. Unfortunately, there is no definitive guideline from the literature to assist us in this regard.

⁴ Readers are referred to Caliendo and Kopeinig (2005) for details of the implementation procedure. Only a brief account of the procedure as related to our problem is presented in this outline.

In our empirical exercise, we consider the following possible covariates (i) age of household head, (ii) gender of household head, (iii) education level of household head, (iv) family size (i.e., number of family members older than 14), (v) ratio of females in the family, (vi) land size (size of own land), (vii) farm distance to market, (viii) farm distance to highway, (ix) quantity or value of production assets, (x) quantity or value of transportation assets, (xi) quantity or value of consumption assets, and (xii) provincial or other geographic dummy variables.

The second step involves the choice of the matching algorithms. Many matching algorithms exist and in principle should produce similar results asymptotically, i.e., with sufficiently large samples. It can generally be classified into three main types (i) one-to-one matching, (ii) one-to-many matching, and (iii) interval matching. The nearest neighbor matching method (caliper matching) is probably the most straightforward one-to-one matching technique. A comparable farm is chosen from the noncontract group of farmers as a matching partner for a contract farm with the closest propensity score. To alleviate the potential problem of bad matches when its closest neighbor is very far away, caliper matching imposes an allowable maximum distance for the propensity scores for matching purposes. This would certainly increase the precision of the match, i.e., decrease the bias as only better matches are allowed, but it would increase the variance as there will be fewer matches.

One-to-many matching uses the weighted average of all or a subset of the control group (noncontract farms) as the counterfactual of a treated member (a contract farm). Radius matching extends the one-to-one caliper matching to include all of the members within the caliper as the comparables. Kernel matching uses a weighted average of all members in the control group to form the counterfactual of a treated member. The kernel is essentially the desired weighting function. For example, a counterfactual can be constructed as the weighted average of the outcomes of all the noncontract farms where the weight given to each noncontract farm is in proportion to its closeness to the contract farm in question. Again, the basic idea here is to use all the information so as to decrease the variance.

Stratification or interval matching basically divides the data into several probability bins and the treatment effect can then be calculated as the average differences between the outcomes of contract and noncontract farmers within each bin. This is in fact the method originally proposed by Rosenbaum and Rubin (1983). They showed that stratification at the quintiles of the propensity scores may eliminate approximately 90% of

the bias. In our empirical assessment, we will follow the stratification procedure as is implemented in the Stata `pscore` module developed by Becker and Ichino (2002):

- (i) After farmers' propensity scores are estimated, they are divided into k equally spaced (usually $k = 5$) strata based on their propensity scores.
- (ii) Within each stratum, test to see whether the average propensity scores differ between the contract and noncontract farmers.
- (iii) If the test fails in (ii), split the stratum in half and test again until the average propensity scores in all strata do not differ between contract and noncontract farmers. In fact, steps (ii) and (iii) also ensure us that there are sufficient overlapping regions (common support) for the ensuing comparison (step 3 in the PSM implementation procedure).
- (iv) This step is essentially step 3 in the general PSM implementation procedure in assessing the matching quality. The idea is to check how well the matching procedure is able to "balance" the covariates between the contract and noncontract farmers. Specifically, the procedure implemented in `pscore` tests that the means of *each* covariate do not differ between the contract and noncontract farms within each stratum. In other words, each stratum should be balanced in the sense that farmers in it do not have significantly different characteristics.
- (v) If the test fails in step 4, i.e., the means of one or more covariates differ, the balancing condition is not satisfied and remedial actions, such as adding higher order or interaction terms to the propensity score model, will generally be taken.

After the balanced strata are formed, we can now compare the performance of contract and noncontract farmers in each stratum. As such comparisons are based on stratification control for farmers' characteristics differences, the performance differences between contract and noncontract farmers would be more likely caused by contract farming rather than farmers' intrinsic characteristics. Finally, the performance difference between contract and noncontract farmers can be measured by the weighted average of the contract and noncontract differences in each group with the number of observations in each group as the weights. As noted above, stratification or interval matching is one of several possible matching methods available. In this study, we also employ the nearest matching technique in addition to stratification to test the robustness of the final results.

While PSM comparison tries to compare the performance of contract and noncontract farmers with similar intrinsic characteristics, hidden bias may still remain because PSM comparison only controls for observed variables (to the extent that they are perfectly measured). For example, farmers'

motivation may be an unobserved covariate affecting both farmers' performance and their choices of joining the contract. We will address this in the endogenous switching regression model below.

3.4 ENDOGENOUS SWITCHING REGRESSION MODEL

Selection models can be used to address unobservable selection biases in deciding to join the contract or not. There are several different formulations of the selection models in the literature such as the standard Heckman model, standard switching regression model, Roy model, and the structural self-selection model (see Li and Prabhala [2007] for a detailed account of these various formulations). In this study, we use the more general structural self-selection model or the endogenous switching regression model to account for both the observed and unobserved selection biases. The endogenous formulation also allows the selection to be driven by both exogenous and outcome variables. Following Lokshin and Sajaia (2004), we use three equations to portray the behavior of farmers:

$y_{1i} = \beta_i X_{1i} + \varepsilon_{1i}$	Profit (or other performance) function of contract farmers
$y_{0i} = \beta_0 X_{0i} + \varepsilon_{0i}$	Profit function of noncontract farmers
$t_i^* = \delta(y_{1i} - y_{0i}) + \gamma Z_i + \mu_i$	Contract selection function

Note that t_i^* is an unobserved latent response variable that reflects the farmer's contract choice, where farmer i would join the contract if $t_i^* > 0$ or stay outside the contract if $t_i^* \leq 0$.

We assume that the error terms in the above three equations (i.e., μ_i , ε_{1i} , and ε_{0i}) follow a trivariate normal distribution. The variance of μ_i is unobservable and hence normalized to unity. As a farmer cannot simultaneously be a contract farmer and a noncontract farmer, the covariance between ε_{1i} and ε_{0i} are unobservable and hence cannot be estimated. The covariance between μ_i and ε_{1i} (denoted as σ_1) and the covariance between μ_i and ε_{0i} (denoted as σ_0) are two parameters that would be estimated.

Based on the endogenous switching regression model laid out above, the maximum likelihood estimation method is used to estimate the parameters in the three equations together with the variance of ε_{1i} and ε_{0i} , the covariance of μ_i and ε_{1i} (σ_1), and the covariance of μ_i and ε_{0i} (σ_0).

After the parameters are estimated, we can calculate

$$xb_{1i} = E(y_{1i} | x_{1i}) = x_{1i}\beta_1$$

$$xb_{0i} = E(y_{0i} | x_{0i}) = x_{0i}\beta_0$$

$$yc_{1_{1i}} = E(y_{1i} | I_i = 1, x_{1i}) = x_{1i}\beta_1 + \sigma_1\rho_1 f(\gamma Z_i)/F(\gamma Z_i)$$

$$yc_{0_{1i}} = E(y_{0i} | I_i = 1, x_{1i}) = x_{1i}\beta_0 + \sigma_0\rho_0 f(\gamma Z_i)/F(\gamma Z_i)$$

$$yc_{0_{0i}} = E(y_{0i} | I_i = 0, x_{0i}) = x_{0i}\beta_0 - \sigma_0\rho_0 f(\gamma Z_i)/[1 - F(\gamma Z_i)]$$

$$yc_{1_{0i}} = E(y_{1i} | I_i = 0, x_{0i}) = x_{0i}\beta_1 - \sigma_1\rho_1 f(\gamma Z_i)/[1 - F(\gamma Z_i)]$$

xb_{1i} represents the unconditional expectation of farmers' performance under the contract; xb_{0i} represents the unconditional expectation of farmers' performance without the contract; $yc_{1_{1i}}$ represents the conditional expectation of contract farmers' performance under the contract; $yc_{0_{1i}}$ represents the conditional expectation of contract farmers' performance without the contract; $yc_{0_{0i}}$ represents the conditional expectation of noncontract farmers' performance without the contract; and $yc_{1_{0i}}$ represents the conditional expectation of noncontract farmers' performance with the contract. σ_1 and σ_0 are the standard errors of ε_{1i} and ε_{0i} ; ρ_1 is the correlation coefficient between ε_{1i} and μ_i ; and ρ_0 is the correlation coefficient between ε_{0i} and μ_i .

$yc_{1_{1i}}$ and $yc_{0_{1i}}$ represent, respectively, the average of contract farmers' actual performance under the contract and the average of their counterfactual performance without the contract. The difference $\Pi_0 = yc_{1_{1i}} - yc_{0_{1i}}$ provides a measure of the impact of contract farming on the performance of farmers who actually chose to join the contract. $\Pi_1 > 0$ (or $\Pi_1 < 0$) would indicate a positive (or negative) impact of contract farming. Similarly, $\Pi_0 = yc_{1_{0i}} - yc_{0_{0i}}$ provides a measure of the impact of contract farming on the performance of farmers who actually chose not to join the contract.

The estimated correlation coefficients, ρ_0 and ρ_1 , provide interesting insights of the sampled farms in choosing the contractual arrangement. For example, when $\rho_1 > 0$, farmers that actually chose to enter the contractual arrangement, have above average performance under the contract. Average performance in this case is defined as $x_i\beta_1$, assuming all farmers in the sample were subjected to the contractual arrangement. In other words, a positive ρ_1 implies "positive selection" into choosing the contract. Furthermore, if noncontract farmers had, in fact, chosen to join the contract,

their performance would be worse than those farmers who actually chose to enter the contract. On the other hand, $\rho_1 < 0$ implies “negative selection” into choosing the contract, or farmers that actually chose to enter the contractual arrangement have below average performance under the contract. In this case, if the noncontract farmers had, in fact, chosen to join the contract, their performance would be above that of the contracted farmers.

Conversely, $\rho_0 > 0$ implies “negative selection” into not choosing the contract for the noncontract farmers. In other words, noncontract farmers have below average performance and if the contract farmers had, in fact, chosen not to join the contract, their performance would be above that of the noncontract farmers. If $\rho_0 < 0$, there is “positive selection” into not choosing the contract for the noncontract farmers, or farmers who actually chose not to enter the contract have above average performance. In this case, if the contract farmers had, in fact, chosen not to join the contract, their performance would be worse than that of the noncontract farmers.

Following Maddala (1983) and Hamilton and Nickerson (2003) but using the correlation coefficients instead of the covariances, four interesting cases can be discerned from the two correlation coefficients:

Case 1. $\rho_0 < 0$ and $\rho_1 > 0$. In this case, farmers who chose to enter the contractual agreement have above average performance and farmers who chose not to enter the contract also have above average performance. In other words, both contract and noncontract farmers chose the correct or appropriate tactics that gave them a relative advantage. This case may be characterized as a situation where both contract and noncontract farmers are in fact capturing their “comparative advantage.”

Case 2. $\rho_0 > 0$ and $\rho_1 > 0$. In this case, farmers who actually chose to enter the contract (i.e., the contract farmers) would have above average performance whether they chose to enter the contract or not. In other words, contract farmers have an “absolute advantage” or they could have better farms in general. Conversely, noncontract farmers have below average performance whether they chose to enter the contract or not. Thus, it could be that their farm is not as good as that of a contract farmer.

Case 3. $\rho_0 < 0$ and $\rho_1 < 0$. This is exactly the opposite of case 2 in the sense that the noncontract farmers have an “absolute advantage.” That is, they

would have above average performance whether they chose to enter the contract or not. In this case, contract farmers have below average performance whether they chose to enter the contract or not.

Case 4. $\rho_0 > 0$ and $\rho_1 < 0$. In this case, farmers chose the tactics that gave them a “comparative disadvantage.” In other words, contract farmers would perform better without a contract and noncontract farmers would perform better under a contract. This should not happen most of the time, except when there are factors which may force farmers to adopt less desirable tactics.

3.4.1 Model Specifications and Estimation Strategies

We use profits (per unit of land) as the major measure of farm performance. There are two types of profits: cash profit and net profit. Cash profit is equal to farmers’ cash revenue minus their cash expenses, while net profit also takes into account farmers’ producing for self-consumption and the supply of their own labor, seeds, and/or other inputs. As net profit is more comparable across farms, we use it as the measure to evaluate the impacts of contract farming on farm performance all of our cases.

Based on the sample size of each dataset and available data in it, we use two specifications to model the farmers’ profit function. For datasets with enough observations and sufficient data on input prices, we use a complete profit function specification, including the price of output, the prices of variable inputs, and fixed assets (i.e., land and farm capital). For datasets that lack observations or price data, we use ad hoc specifications that include mainly land, capital, and family labor in the profit functions. We use complete profit function specifications in the cases of rice farming in Thailand (the 2003 dataset) and rice farming in Cambodia. For the other cases, we use ad hoc specifications.

Based on the endogenous switching regression model formulation as described above, we use Lokshin and Sajaia’s “movestay” module in the Stata program to evaluate factors that affect farmers’ decision of joining the contract and their performance with or without the contract.

3.5 PROPENSITY SCORE MATCHING VS. ENDOGENOUS SWITCHING REGRESSION MODEL

While the goal of both PSM and selection models are the same, i.e., to create a quasi-randomized treatment and control groups for a “fairer” assessment of the treatment effect, the way they handle the situation is radically different. The key difference is that PSM assumes that the unobservable information is irrelevant to outcomes while selection models incorporate the effect of the unobservable information in estimating the outcomes. Furthermore, PSM estimates the treatment effects directly while selection models estimate the treatment effects indirectly through the estimated parameters of the estimated equations.

It is clear from the above discussion that if the unobserved covariates are of no significance in determining the selection mechanism, PSM can be rightfully considered a pseudo-randomized process and thus the ensuing estimated treatment effect is unbiased. In this case, PSM is probably more preferable as it is simple, direct, and transparent. In addition, it does not need to explicitly specify the functional form as in selection models. It certainly does a better job of controlling for observable characteristics with explicit checking of covariate balancing and clarification of the common support region.

However, if the unobservable characteristics are thought to affect outcomes, selection models, such as the endogenous switching regression model described in this chapter, would be appropriate. While the endogenous switching regression is the most general form of the class of selection models, it is also the most demanding with respect to the underlying assumptions. As discussed above, estimation of the endogenous switching regression requires a trivariate normal distribution of the error terms. Furthermore, the endogenous formulation requires that the system of equations is identified. The identification requires that we have at least one instrumental variable that affects treatment (contractual) choice but does not directly affect outcome. Identifying the appropriate instruments is probably the most challenging in using the endogenous switching regression model. That is exactly why we proposed to use both PSM and the richer formulation of the endogenous switching regression model to assess the effects of contract farming in this study. Depending on the situation at hand, one method may be more preferable as discussed.

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4. Contract Farming and Poverty Reduction: The Case of Organic Rice Contract Farming in Thailand¹

Junning Cai, Sununtar Setboonsarng, and PingSun Leung



4.1 INTRODUCTION

Among the poor in Asia, a very high proportion are subsistence farmers living on low-value traditional crops. Development in the agriculture sector has customarily placed emphasis on increasing productivity using external inputs with insufficient attention on other aspects, in particular to market linkages. This strategy has resulted in mixed poverty outcomes. In countries such as Cambodia and the Lao People's Democratic Republic (Lao PDR) where poverty is a pervasive problem, governments and donors are in search of an alternative strategy to develop the rural sector.

With globalization, market liberalization, and the development of rural infrastructure, new market opportunities for high-value crops and livestock production are opening up. However, for the rural poor to take advantage of new market opportunities, backward and forward market linkages must be put in place. These linkages include provision of information on rural credit, farming inputs, agricultural extension advice, and help in product accreditation. Putting in place the necessary agriservices for a massive number of small farms and unorganized farmers will require considerable resources from governments. Successes in the provision of public sector agriservices are rare and failures have been numerous.

In recent years, a strategy involving the private sector has been looked upon as an alternative. In the provinces of Cambodia and the Lao PDR bordering Thailand and the People's Republic of China (PRC), contract farming has emerged in response to a lack of markets in an environment of high risk and high costs. Under contract farming, the purchaser (agribusiness firm or trader) provides farmers with inputs, credit, technical advice, and market services. In return, farmers produce a certain quantity and quality of crop or livestock, and sell them exclusively to the purchaser. Such arrangements allow farmers to have access to an array of agricultural services, to which they would otherwise not have access.

¹ First published as Setboonsarng, S., J. Cai and P.S. Leung. 2006. "Contract Farming and Poverty Reduction: the Case of Organic Rice Contract Farming in Thailand." ADBI Discussion Paper 49. Tokyo: Asian Development Bank Institute. Available: <http://www.adbi.org/files/2006.05.dp49.pr.organic.farming.thailand.pdf> This chapter was subsequently published in J. Weiss and H.A. Khan. 2006. (eds), *Poverty Strategies in Asia*, Chapter 10, Cheltenham, UK and Northampton, MA, USA: Edward Elgar Publishing, pp 266–299.

The emergence of contract farming as an institution for facilitating market exchange is not a recent phenomenon. For decades, contract farming has been used as a supply chain governance strategy in response to market and institutional failures that characterize the agriculture sector in different stages of development. While contract farming itself has been around for a long time, its importance as a tool for transforming subsistence to commercial farmers and thus contributing to poverty reduction has only been reviewed in recent years.

Internationally, in response to changes in consumer preference within developed countries, multinational food corporations are engaging in contract farming in developing countries, mainly to ensure year-round supply of particular products to specific markets and to take advantage of lower production costs. It appears that through globalization, this type of contract farming could possibly transfer a production base to developing countries such as Cambodia and the Lao PDR where conditions are conducive for growing nontraditional export crops, and where labor and land costs are lower. If managed well, this trend offers promising opportunities for the rural poor in these countries to gain from globalization, providing access to a vastly growing export market and hence opportunities to improve rural incomes.

In the neighboring country of Thailand where agriculture development is in a more advanced stage and where contract farming has been widely adopted, there are important lessons to be learned for Cambodia and the Lao PDR. Due to the growing demand of organic rice in developed countries, in 2003, the Ministry of Agriculture and Cooperatives of Thailand commissioned a study to investigate the potential of developing organic rice in Thailand for export. The study included a farm household survey covering 445 contract and noncontract rice farming in five provinces in the north and northeastern regions. The farms covered in the dataset share many characteristics with the rural sector in Cambodia and the Lao PDR, where the vast majority are smallholder farms in marginal areas, with excess labor and little or almost no access to agricultural extension services. These data are examined in this chapter using econometric analysis to evaluate the profitability and profit efficiency of rice contract farming, as compared to rice noncontract farming in Thailand.

4.1.1 Potential Benefits of Contract Farming and Organic Agriculture

The existing literature on contract farming identifies several major areas where contract farming can provide benefits. From the point of view of

farmers, contract farming can provide access to markets, credit, technology, and inputs from which they would otherwise be excluded. Moreover, contract farming can lead to improvements in income, while reducing some of the risks they face from production and price fluctuations. From the point of view of purchasers, contract farming provides greater control over volume and quality consistency; to a certain extent, it can also lower certain transaction and production costs that purchasers face. Table 4.1 summarizes the main potential benefits.

Table 4.1 Potential Benefits of Contract Farming

Parameter	Potential Benefits
Farmers	
Access to markets	Contract farming arrangements serve to link farmers to distant markets where the demand and price of crops are more favorable.
Access to credit	Purchasers extend credit to farmers either in cash or in kind by providing inputs such as seeds. In cases where purchasers do not extend loans to farmers, banks may accept the contracts as collateral.
Access to technology / skills development	Contract farming arrangements may facilitate the introduction of new production techniques and further measures that upgrade agricultural commodities. These include training and assistance in crop production, soil and water management, and bookkeeping of inputs and outputs.
Access to inputs	Purchasers may undertake measures to ensure that contracted producers have timely access to inputs including seeds and fertilizers, in addition to training support and monitoring proper crop husbandry practices.
Increased income	Contract farming can lead to improved income, especially in cases where contract farming is adopted for nontraditional crops that are sold at a premium.
Reduced price risk	In contract farming, a predetermined price for the crop is generally established during contract negotiations at the onset of the growing season. This may protect farmers from incurring losses in sales due to downward price fluctuations.
Reduced production risk	Contract farming arrangements facilitate risk sharing from production failures due to uncontrollable circumstances including weather or disease. Purchasers may absorb losses associated with reduced or nonexistent throughput for the processing facility. Where production problems are widespread as a result of uncontrollable events, purchasers may defer the repayment of production advances until the following season.

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Table 4.1 *continued*

Purchasers	
Control over volume and consistency	Contract farming assures suppliers that the required crops can be produced consistently. Contract farming may result in increased yields and improved quality with regard to certain types of crops.
Improved cost efficiency	Contract farming allows firms to minimize costs by not purchasing land or directly hiring labor. Contract farming can help firms minimize supervision costs, usually incurred due to classic principal-agent problems.

Source: Authors’ compilation from case studies in this book.

Contract farming likewise affords potential benefits to governments. While the development of market linkages for farmers is traditionally viewed as a public sector responsibility, the establishment of the necessary agroservices for a large number of small, un-organized farmers requires a considerable amount of public sector resources. On the other hand, contract farming provides market linkages in ways that do not burden the public sector.

4.1.2 Contract Farming and Organic Agriculture

In recent years, consumer concerns surrounding food safety have led to an increase in demand for organic products. The global market for organic products has been growing steadily, not only in Europe and North America but also in Asian countries such as Japan and the PRC. This has greatly benefited farmers from developing countries who have increased exports in organics and received substantial price premiums.

This increase in demand has come with a greater insistence on verifiable evidence of safety and quality as chemical residues on food are generally only detected with costly biochemical tests. To guarantee the quality of products while minimizing transaction costs, certification systems and traceability systems are becoming the norm in global agritrade to provide information on products for consumers, specifically in developed countries.

For export agents in developing countries, the ability to fulfill the traceability or certification requirements will determine their success in the export market, particularly in high-value products such as organic products whose strict quality requirements are difficult to meet in spot markets. As such, agrifirms utilize contract farming to gain better control of inputs, achieve uniform product attributes, and reduce the cost of

measuring quality, grading, and sorting of agriproducts. Given the high production management costs, particularly the requirement for organics to be grown in areas free from chemicals, export firms are likely to engage farmers in marginal areas, where the cost of labor is lower and the use of agrochemicals is minimal.

Beyond issues of establishing the requisite certification standards and traceability systems to promote exports, there are broader benefits from promoting contract farming of organic produce for poverty reduction. Over the years, it has become increasingly clear to farmers, nongovernment organizations (NGOs), governments, and international development agencies alike that the conventional practice of farming under the banner of the “Green Revolution” has bypassed the poor in marginal areas and benefited mainly the richer farmers in fertile areas. There is also increasing evidence that high-external input agriculture is unsustainable as reports on stagnant or declining yields, increasing ecological degradation, and worsening rural socioeconomic conditions have increased. This has led countries to look at organic agriculture as a means of reversing these negative effects.

While the benefits of implementing contract farming may be diverse, and various stakeholders stand to gain from these benefits, persuading farmers to take part in such an arrangement is still largely a matter of financial incentives. In contract farming, one of the principal motives for smallholders’ consent is the promise of a steady and increased income incurred from the sale of their crops. To show the benefits of contract farming, empirical evidence is provided in this chapter using data from small farms in Thailand.

4.2 METHODOLOGY

The chapter employs the profit-frontier methodology to assess the profitability and profit efficiency of the sampled Thai rice farmers (see Appendix 1 for the mathematical description of the model). Profit efficiency is defined here as the ratio of the observed profit to the potential maximum attainable profit. While profit provides a direct measure of relative competitiveness of one type of farm (contract farm) in relation to others (noncontract farm), the concept of profit efficiency can also be useful as an indicator of relative competitiveness. We also attempt to account for selection bias using a two-stage switching regression model. The estimated models are used for subsequent “counterfactual” simulations of profit and profit efficiency (see Chapter 3 for the mathematical description of the model).

The analysis aims to test the following hypotheses:

- (i) Contract rice farmers are more profitable than noncontract farmers for comparable scales of operation.
- (ii) Contract rice farmers are more (profit-)efficient than noncontract rice farmers for comparable scales of operation.
- (iii) Contract farming is biased against small farmers.

Since all contract rice farmers in the sample are certified organic or in transition to becoming organic farmers and all the noncontract farmers are conventional rice farmers, the analysis also throws some light on the debate concerning organic versus conventional agriculture. However, the evidence on this must be interpreted with care and it is difficult to draw firm conclusions. This is partly because we cannot separate the effects of an institutional arrangement (a contract) from a technology (organic farming practices) as the contract farming group is influenced by both. Furthermore, not all contract farmers are certified organic farmers who have completed the required 3-year transition period, although we can distinguish between the pure (or certified) organic farmers and those who are either in transition or just starting out to adopt organic practices.

4.2.1 Efficiency and Profit Frontiers

Efficiency and inefficiency can generally be measured by their components—technical, cost, revenue, and profit. Technical efficiency refers to a farm's ability to produce the maximum outputs for a given set of inputs and technology. Or conversely, it can be measured as the farm's ability to utilize the minimum amount of inputs to produce a desirable set of outputs for a given technology. Cost efficiency refers to the ability of a farm to minimize the expenditures required to produce a desirable set of outputs, given their respective input prices and production technology. Misallocation of inputs contributes to cost inefficiency and is sometimes referred to as input allocative inefficiency. Revenue efficiency refers to a farmer's ability in allocating his or her outputs in a revenue-maximizing manner for a given set of output prices. Finally, profit efficiency refers to a farm's ability to obtain maximum profit for a given set of input prices, output prices, and technology. While technical, cost, and revenue efficiency are necessary for the achievement of profit efficiency, they are collectively not sufficient for profit efficiency. Profit efficiency further requires that technical, cost, and revenue efficiency be achieved at the proper scale; that is, it requires some kind of scale efficiency (Kumbhakar and Lovell 2000).

Here we utilize a dual variable profit frontier, which portrays the maximum variable profit (defined as gross revenue less variable cost) obtainable by a farm given the prices of inputs and outputs, the production technology, and the presence of fixed inputs such as land and capital. The variable profit frontier is more appropriate when farms do not have the flexibility to adjust all inputs. Farms operating on the profit frontier are profit-efficient, while farms operating under the profit frontier are profit-inefficient.²

4.2.2 Other Studies Using Profit Frontier Analysis

In terms of the wider literature, while rice is perhaps the most studied agricultural commodity by researchers, very few have used profit frontiers, which could be due to lack of appropriate data. In a review article by Bravo-Ureta and Pinheiro (1993) on efficiency analysis of developing country agriculture, 13 out of 20 studies were on rice farming. However, only two studies used the dual-profit frontier approach and only one was on rice farming. Ali and Flinn (1989) used a single equation dual-profit frontier to examine the efficiency of 120 rice producers from Punjab Province in Pakistan. They found that the average inefficiency was 31%. Education was found to play a significant role in reducing profit inefficiency, while off-farm employment and difficulties in securing credit to purchase fertilizer tended to increase profit inefficiency.

Since 1993, a few more studies have employed profit frontiers. Abdulai and Huffman (2000) used a stochastic translog profit frontier to examine the efficiency of 256 farmers in the northern region of Ghana. They found that the average inefficiency was 27.4%. Their inefficiency analysis suggested that education of the household head, access to credit, greater specialization, and location in districts with better access to extension services and better infrastructure were significant variables for increasing profit efficiency. On the other hand, increasing participation in nonfarm activities by farmers and being older tended to lower profit efficiency. Rahman (2003) also used a dual-profit translog frontier to investigate the efficiency of 380 farms, which produced a modern variety of rice in three agroecological regions of Bangladesh. He found that the average inefficiency was about 23%. Farmers with more experience in growing modern varieties of rice, better access to input markets and extension services, located in fertile regions, as well as those with less off-farm work and who owned their land were found to be more efficient.

² Our analysis follows Battese and Coelli (1988, 1995); for further details, see Coelli, Rao, and Battese (1998).

To our knowledge, there are no other efficiency studies on rice farming which employ the stochastic profit-frontier approach. However, there are several efficiency studies of other agricultural products using the stochastic frontier approach since the 1993 review article by Bravo-Ureta and Pinheiro. Araujo and Bonjean (1999) used a stochastic profit frontier to study the efficiency of different land tenure patterns in Brazilian farms. Bhattacharyya and Glover (1993) also employed a stochastic profit frontier to examine the efficiency of small versus large farms in India. Wang, Wailes, and Cramer (1996) developed a shadow-price profit frontier model to examine the efficiency of rural households in the PRC in farming operations. Delgado, Narrod, and Tiongco (2003) employed the profit frontier approach to investigate the efficiency of large versus small, and contract versus independent livestock farms in Brazil, India, the Philippines, and Thailand.

4.2.3 Thai Data

In 2003, the Ministry of Agriculture and Cooperatives of Thailand commissioned a survey to investigate the potential of developing organic rice in Thailand for export; the data were subsequently updated with interviews in 2005. The survey covers five provinces, two of which are in the northern region (Phayao and Chiang Rai), while the other three are in the northeastern region (Ubon Ratchathani, Surin, and Yasothon).

The sampled farms in Northeast Thailand practiced conventional agriculture using a high level of agrochemicals until the early 1980s. In the mid-1980s, in Surin and Yasothon provinces, the movement of natural agricultural practices and environmental conservation promoted by religious groups and several NGOs initiated contract farming of organic rice as a solution to the problems faced by farmers. This development was then supported by European NGOs that wished to produce organic rice for export to their own fair trade networks. In Ubon Ratchathani, contract farming of organic rice was supported by a semi-NGO as part of its strategy for community development and poverty reduction. It was also an income-earning opportunity for the NGO. In contrast, organic rice farming in the northern region was a private-sector-led initiative, prompted by demand growth in European countries. In search for land where chemicals have not been applied for organic production, the firms searched for marginal forest areas and introduced rice contract farming to farmers.

The farm survey was conducted during 2002 and 2003 with an updated interview with key informants during early 2005. Hence, the monetary

data are in 2002–2003 prices. Within each province, approximately the same number of contract and noncontract farmers was surveyed in the same locality. All of the contract rice farmers are organic or low-chemical farmers, while all the noncontract farmers are conventional rice farmers. This resulted in 83 contract-organic and 85 conventional farmers surveyed in the northern region, and 140 contract-organic and 137 conventional farmers in the northeastern region. Thus, there are a total of 445 farms surveyed, 168 in the northern region and 277 in the northeastern region (Table 4.2).

Table 4.2 Distribution of Sampled Rice Farms by Region, Province, and Special Groups

Region	Province	Group	Type of Rice Produced by Group	No. of Sample
North	Phayao	Certified organic	Certified organic rice	20
		Conventional	Conventional (using chemical inputs)	23
	Chiang Rai	Certified organic	Certified organic rice	21
		Transitional organic	Transitional organic rice	21
		Initial organic	Initial organic rice	21
		Certified organic	Conventional (using chemical inputs)	62
		<i>Subtotal (Sample of contract rice farmers)</i>		83
		<i>Subtotal (Sample of noncontract rice farmers)</i>		85
	Ubon	Certified organic	Certified organic rice	52
	Ratchathani	Conventional	Conventional (using chemical inputs)	47
		Certified organic	Certified organic rice	14
North-East	Surin	Transitional	Transitional organic rice	17
		Initial	Chemical safe (no chemical fertilizer)	11
		Conventional	Conventional (using chemical inputs)	45
		Certified organic	Growing organic rice more than 5 years	15
	Yasothon	Transitional organic	Growing organic rice for 2–4 years	15
		Initial organic	First year transitional organic rice	16
		Conventional	Conventional (using chemical inputs)	45
		<i>Subtotal (Sample of contract rice farmers)</i>		140
		<i>Subtotal (Sample of noncontract rice farmers)</i>		137
	Total Sample		Total sample of contract rice farmers	223
			Total sample of noncontract rice farmers	222

Source: 2003 Ministry of Agriculture and Cooperatives survey results, Titapiwatanakun (2005).

The contract-organic farms in the survey are categorized into three groups according to the length of their organic farming experience and the restrictions on their farming practices. Farmers in the “certified” organic group include those certified to avoid totally the use of chemical fertilizer, pesticides, or herbicides. They have mostly more than 4 years of organic farming experience. The “transitional” organic farming group represents farms, mostly are 2–4 years into organic farming, while the “initial” organic farming group represents farms that have just gone organic (mostly 1–2 years into organic farming). Those in the “transitional” or “initial” organic groups, in principle, should be committed to stop using chemical fertilizer, pesticides, and herbicides. The fact that some still do is likely due to an ineffective inspection and certification system.

In this sample, all organic farmers are contract farmers, while all conventional farmers are noncontract farmers. All certified and transitional organic farmers received a premium price based on their years of organic practice. However, not all contract farmers are pure organic farmers, making it impossible to completely merge the organic and contract groups. Table 4.2 gives the division between different categories of farmers within regions and provinces.

Information on quantity and value of rice output and major inputs were gathered in the farm survey. The major inputs include seed, hired and family labor, chemical fertilizer, organic fertilizer, pesticides and herbicides, fuel, machinery rental, land, and capital assets. In addition, data were collected on the characteristics of farmers and farms.

Table 4.3 provides a summary of the characteristics of the sampled farms by contract and noncontract farmers and by region. Overall, household heads for contract farms were significantly³ younger (age 49 vs. 51 years) and better educated (2.86 vs. 2.36 years of formal education) than for noncontract farms. These differences were also true for the two regions except that there was no significant difference between the age of the household heads between contract and noncontract farms in the northern region. With respect to experience in organic rice farming, contract farmers in the North were significantly more experienced than those in the Northeast (5.83 vs. 3.23 years).

³ Significance herein refers to statistical significance.

Table 4.3 Characteristics of Sampled Farms

	Total Sample Means	Noncontract Farmers Means	Contract Farmers Means	p-value*
Total (No. of farms)	445	222	223	
Age of household head (years)	49.66	50.80	48.52	0.0261
Education of household head (years)	2.61	2.36	2.86	0.0000
No. of household members engaged in rice farming	2.38	2.39	2.37	0.8384
Female members engaged in rice farming (%)	0.51	0.52	0.51	0.7310
Land allocated to rice (rai/farm)	12.10	10.71	13.48	0.0003
Land ownership (%)	90	86	94	0.0040
Years in rice farming	40.16	38.53	41.78	0.1378
Years in fragrant (Hom Mali) rice farming	12.64	13.50	11.79	0.0093
Years in organic rice farming	2.10	0.00	4.20	0.0000
% of saline soil	7	8	6	0.4430
% of income from nonagricultural activities	12	13	11	0.4650
% of agricultural income from rice farming	61	59	63	0.3920
% of labor from family	72	73	72	0.7475
% of seed from own supply	56	58	55	0.5299
% of organic fertilizer from own supply	41	34	48	0.0005
North (No. of farms)	168	85	83	
Age of household head (years)	47.90	47.56	48.24	0.6660
Education of household head (years)	2.52	2.32	2.72	0.0229
No. of household members engaged in rice farming	2.14	2.15	2.13	0.8625
Female members engaged in rice farming (%)	0.48	0.50	0.46	0.5890
Land allocated to rice (rai/farm)	11.98	10.23	13.77	0.0044
Land ownership (%)	85	76	94	0.0013
Years in rice farming	35.47	32.21	38.81	0.0858
Years in fragrant (Hom Mali) rice farming	10.45	8.65	12.29	0.0164

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Table 4.3 *continued*

	Total Sample Means	Noncontract Farmers Means	Contract Farmers Means	p-value*
Years in organic rice farming	2.88	0.00	5.83	0.0000
% of saline soil	5	6	4	0.4931
% of income from nonagricultural activities	8	7	9	0.7390
% of agricultural income from rice faming	5	56	60	0.5650
% of labor from family	66	67	65	0.6900
% of seed from own supply	42	38	47	0.2229
% of organic fertilizer from own supply	15	4	26	0.0000
Northeast (No. of farms)	277	137	140	
Age of household head (years)	50.72	52.81	48.68	0.0019
Education of household head (years)	2.67	2.39	2.94	0.0004
No. of household members engaged in rice farming	2.53	2.54	2.51	0.8482
Female members engaged in rice farming (%)	0.54	0.54	0.53	0.9690
Land allocated to rice (rai/farm)	12.17	11.01	13.31	0.0169
Land ownership (%)	93	92	94	0.4478
Years in rice farming	43.00	42.45	43.54	0.6747
Years in fragrant (Hom Mali) rice farming	13.97	16.50	11.49	0.0001
Years in organic rice farming	1.63	0.00	3.23	0.0000
% of saline soil	8	9	7	0.6204
% of income from nonagricultural activities	14	16	12	0.2790
% of agricultural income from rice farming	62	61	64	0.5320
% of labor from family	76	76	76	0.8783
% of seed from own supply	65	70	59	0.0588
% of organic fertilizer from own supply	56	53	60	0.1223

* p-value is the smallest level of significance for which we can reject the respective hypothesis test of difference in means between contract and noncontract farmers using the appropriate t-test.

Source: Authors' calculations.

The average number of household members engaged in rice farming was very similar for contract and noncontract farmers (2.37 vs. 2.39 persons) overall and in both regions. The percentage of female members engaged in rice farming was also very similar for contract and noncontract farmers (51% vs. 52%) overall and in both regions. Overall, contract farmers allocated an average of 13.48 rai of land to rice farming, which was significantly higher than the noncontract farmers who allocated only 10.71 rai. Similar patterns were also exhibited in both regions. With respect to land ownership, while there was no significant difference between contract and noncontract farmers in the Northeast, contract farmers in the North had a higher percentage of ownership than the noncontract farmers (94% vs. 76%). While the percentage of income derived from nonagricultural activities was significantly lower for the farms in the North (8%) than in the Northeast (14%), there were no significant differences between the two contracting groups within each region. As to the percentage of agricultural income derived from rice farming, there were no significant differences between regions and within the two contracting groups.

While farms in the northeastern region used a significantly higher percentage of family labor (76%) when compared to the North (66%), there were no significant differences between contract and noncontract farmers within each region. While the contract and noncontract farmers in the North on average showed no significant differences in using their own seeds, noncontract farmers in the Northeast used significantly more seeds from their own supply than contract farmers (70% vs. 59%). In terms of utilization of organic fertilizers, contract and noncontract farmers in the North used similar percentage in their respective production systems (slightly more than half). However, contract farmers in the Northeast used significantly more organic fertilizer derived from own supply than noncontract farmers (26% vs. 4%).⁴ Finally, both regions had a similar endowment of saline soil and there were no significant differences in soil distribution between contract and noncontract farmers.

Since contract and noncontract farming tend to have different production processes, we estimate their profit efficiency separately.⁵

⁴ It should be noted that there is a high cash cost associated with organic fertilizers, which is interesting as we would normally assume that organic fertilizers are derived from farm wastes (such as compost) and therefore is appropriate for farmers who do not have access to credit. In the case of Thailand, it appears from the survey that there are commercial forms of organic fertilizers, and farmers in the North do have cash to purchase these.

⁵ An alternative is to include contract and noncontract farms in a single estimation and use a dummy variable to distinguish them. However, as pointed out by Delgado, Narrod, and Tiongo (2003), Warnings and Key (2002), and Larsen and Foster (2005), such specifications may lead to self-selection or simultaneity bias since the decision to be a contract or organic farmer may not be independent from other production decisions.

Tables 2A and 3A in the appendix provide the summary statistics of variables used in estimating the profit frontiers for contract and noncontract farms, respectively.

4.3 RESULTS: COMPARATIVE PROFITABILITY

Since our interest is in the estimation of profit inefficiency and its determinants, we do not focus on the estimates of the stochastic profit frontier except for the derived profit elasticities (see Appendix 1 for the estimated results of the frontier profit functions). Table 4.4 shows the profit elasticities with respect to the prices of the six variable inputs and the two fixed factors for both contract and noncontract farms. The profit elasticities of contract farms with respect to seed price, wage, and energy are negative as expected, yet not statistically significant; the elasticities with respect to the prices of chemical fertilizer, organic fertilizer, and machinery are positive, yet insignificant.

Table 4.4 Estimated Profit Elasticities for Farms

Profit elasticity with respect to	Contract Farms		Noncontract Farms	
	Elasticity	p-value	Elasticity	p-value
Variable inputs				
Seed price	-0.242	0.151	0.100	0.414
Wage	-0.076	0.277	-0.017	0.884
Chemical fertilizer price	0.106	0.653	-0.012	0.962
Organic fertilizer price	0.021	0.547	-0.171	0.002
Machinery	0.018	0.447	-0.047	0.108
Energy	-0.052	0.119	-0.001	0.985
Fixed inputs				
Land	0.868	0.000	0.975	0.000
Capital	0.006	0.784	0.027	0.385

Source: Authors' calculations.

As to the noncontract farms, the profit elasticities with respect to all the input prices are of the correct sign except for seed, which is also not statistically significant. For both contract and noncontract farms, profit elasticities with respect to the two fixed factors (land and capital) are also of the right sign, but capital is not statistically significant. The estimated profit elasticities with respect to land are 0.87 for contract farms and 0.98 for noncontract farms, indicating that profit tends to increase by less than 1% with a 1% increase in land allocated to contract or noncontract rice farming.

We first test the hypothesis that “contract rice farmers are more profitable than noncontract rice farmers for comparable scales of operation.” Full data on the calculations are given in the Table A3 in the appendix. Here we focus on two distinct measures of profit: one deducting only direct cash costs from sales revenue (profit over cash costs) and the other deducting both cash and imputed noncash costs (profit over total variable costs). We place most emphasis on profit per unit of land (baht per rai).

The profit results are summarized in Table 4.5, which shows that contract farmers had a significantly higher profit over total variable cost in the overall sample and in each region, but particularly in the Northeast. Contract farmers on average generated a profit over total variable cost of 1,234 baht per rai in the North and 1,098 baht per rai in the Northeast. On the other hand, noncontract farmers produced a profit over total variable cost of 731 baht per rai in the North and only 273 baht per rai in the Northeast. Differences in profitability are less sharp (principally in the North) when costs include only cash costs excluding the imputed value of own inputs, such as family labor and seeds (profits over cash costs).

Differences in profitability can largely be explained by the significantly higher price of rice received by the contract farmers (6.5. vs. 6.0 baht per kilogram in the North and 7.9 vs. 5.9 baht per kilogram in the Northeast). The marked difference in price for organic rice between the two regions is explained by the different price formulae used in private-sector-based contract farming in the North and in an NGO-based system in the Northeast. In the North, the contracting firms offered a fixed margin of 0.5 baht above the market price of conventional rice at harvesting. In the Northeast, the price was fixed at the start of the season based on negotiations between the NGO and the farmers. On the other hand, it is interesting to note that yield in kilogram per rai was very similar for the contract and noncontract farmers in both regions. Average yields are considerably lower in the Northeast, however, due to higher level of land degradation.

Details of the cost structure of farms are given in Table A3 in the appendix. In terms of the role of organic farming practices, it is important to note that while contract farmers in the Northeast contracted to an NGO with broader social objectives, thus appearing wholly organic with zero expenditure on chemical fertilizer, pesticides, and herbicides, the transition and initial organic groups in the North continued to use them, due to an ineffective monitoring system operated by the contracting firms, although at lower levels per rai than noncontract farms. For example, expenditure on chemical fertilizer per rai in the initial organic group was roughly two-thirds of that

Table 4.5 Profitability of Rice Farming in Sample Farms

Area (No. of farms)	Total Sample	Contract/Organic Farms			Total	Noncontract/ Conventional Farms	p-value*
		Certified	Transition	Initial			
North	168	41	21	21	83	85	
Profit over total variable costs							
Profit per unit of land (baht/rai)	980	1,166 ^a	1,309 ^a	1,291 ^a	1,234	731 ^b	0.0000
Profit over cash costs							
Profit per unit of land (baht/rai)	1,847	2,018 ^a	2,042 ^a	1,927 ^a	2,001	1,697 ^a	0.0047
Production/ yield (kg/rai)	464	472 ^a	477 ^a	461 ^a	470	458 ^a	0.3899
Price of rice (baht/kg)	6.26	6.59 ^a	6.45 ^a	6.38 ^a	6.50	6.02 ^b	0.0000
Farm capital assets (baht/rai)	16,378	18,853	17,956 ^{ab}	25,956	20,423	12,427 ^b	0.0073
Northeast	275	40	88	11	139	136	
Profit over variable costs							
Profit per unit of land (baht/rai)	690	1,800 ^a	833 ^a	654 ^{bc}	1,098	273 ^c	0.0000
Profit over cash costs							
Profit per unit of land (baht/rai)	1,644	2,849 ^a	1,867 ^b	1,416 ^c	2,114	1,163 ^c	0.0000
Production/ yield (kg/rai)	346	353 ^a	347 ^a	350 ^a	349	342 ^a	0.5881
Price of rice (baht/kg)	6.89	10 ^a	7.14 ^b	6.29 ^c	7.89	5.87 ^d	0.0000
Farm capital assets (baht/rai)	9,062	8,439 ^a	9,651 ^a	8,614 ^a	9,220	8,901 ^a	0.8257
Total	443	81	109	32	222	221	
Profit over variable costs							
Profit per unit of land (baht/rai)	800	1,479 ^a	925 ^b	1,072 ^b	1,149	449 ^c	0.0000
Profit over cash costs							
Profit per unit of land (baht/rai)	1,721	2,428 ^a	1,901 ^b	1,752 ^b	2,072	1,369 ^c	0.0000
Production/ yield (kg/rai)	390	413 ^a	372 ^a	423 ^a	394	387 ^a	0.4828
Price of rice (baht/kg)	6.65	8.27 ^a	7.00 ^b	6.35 ^c	7.37	5.93 ^d	0.0000
Farm capital assets (baht/rai)	11,836	13,710 ^b	11,251 ^b	19,995 ^a	13,409	10,257 ^b	0.0338

kg = kilogram.

* p-values are for the respective tests of mean difference between contract farmers and noncontract farmers.
 Note: Similar superscript letters across groups denote homogeneous subsets using the Duncan's multiple range test at 5% level of significance.

Source: Authors' calculations.

for conventional farms. Furthermore, organic farmers in the Northeast used more on-farm organic fertilizer than the contract farmers in the North. Invested capital assets (valued at baht per rai) were significantly higher for contract farmers in the North, while there was no significant difference between contract and noncontract farmers in the Northeast. Farmers in the North were generally far more capitalized than the Northeast.

Table 4.5 also shows the differences in profit and cost structure among the three organic farmer groups—certified, transition, and initial—indicating their levels of sophistication in organic farming. While organic farmers in the North, regardless of their stage of transition, achieved similar levels of profit (in terms of profit over cash cost per rai), the certified organic farmers in the Northeast were considerably more profitable than the transitional and initial organic farmers. This is despite the fact that in the North, as we have just noted, there were considerable differences in terms of organic practices between the three different groups, with only the certified group being wholly organic. In the Northeast where profitability was generally lower than the North, the profitability of the initial organic farmers (defined as profit over cash expenditure), who continued to use chemical fertilizers, was roughly 25% above that of conventional farms. This profitability pattern can again be largely explained by the price of rice received by the farmers. While the price of rice was not significantly different among the three organic groups in the North, the price received by the certified organic farmers (10 baht per kilogram) in the Northeast was considerably higher than that received by the transitional and initial organic farmers (7.1 and 6.3 baht per kilogram, respectively) and nearly double of that received by noncontract farmers.

Table 4.6 relates profit to farm size. Profit after cash costs for contract farmers per unit of land decreases with the increase in farm size, while for noncontract farmers profit after cash cost is more stable. We find no support for our third hypothesis and conclude that contract farming as practiced in these areas of Thailand does not seem to be biased against smaller farms in terms of profitability, as is sometimes argued. Furthermore, for all farm sizes, profits are significantly higher for contract farmers, as compared with noncontract farmers.

Selection bias and counterfactual simulation. The above profitability comparison reveals that contract farms in the sample generally have higher profits than noncontract farms. However, this profitability difference does not necessarily indicate that contracting has a positive impact on profits because it could be caused by selection bias. That is, the higher profitability

Table 4.6 Profitability by Farm Size (profit after cash costs per rai)

Land Category	All Farms	Noncontract Farmers	Contract Farmers	p-value*
0–5 rai	1,719 ^a	1,374 ^a	2,432 ^a	0.0000
6–10 rai	1,744 ^a	1,413 ^a	2,076 ^{a,b}	0.0000
11–20 rai	1,723 ^a	1,337 ^a	2,021 ^b	0.0000
>20 rai	1,646 ^a	1,276 ^a	1,866 ^b	0.0057
Total	1,721	1,369	2,072	0.0000

* p-values are for the respective tests of mean difference between contract farmers and noncontract farmers.

Note: Similar superscript letters across farm size denote homogeneous subsets using the Duncan's multiple range test at the 5 % level of significance.

Source: Authors' calculations.

in contract farming may merely reflect the fact that farms with the potential of securing higher profitability are more likely to become contract farms. In other words, these contract farmers might have relatively high profits whether engaging in contract or noncontract farming.

A counterfactual simulation can help sort out the impact of contracting on profitability. In brief, the key to this approach is to estimate farms' counterfactual profits and compare these to their actual profits. The counterfactual profit of a contract farm is defined as the hypothetical profit that it could have earned had it farmed like a (typical) *noncontract* farm. Similarly, the counterfactual profitability of a noncontract farm is defined as the hypothetical profit that it could have earned had it farmed like a (typical) *contract* farm. Noncontract farms in the sample generally sold their rice at lower prices than contract farms. We use the rice prices of contract (or noncontract) farms in the estimation of the counterfactual profits of noncontract (or contract) farms. Higher actual than counterfactual profits for contract farms would indicate that contract farms would have been less profitable had they operated like a noncontract farm. Similarly, lower actual than counterfactual profits for noncontract farms would indicate that noncontract farms would have been more profitable had they operated like a contract farms.⁶

⁶ Methodologically, our counterfactual simulations are based on a switching regression model (Maddala 1983, chapters 8 and 9) and follow the two-stage estimation process suggested by Heckman (1976). Let $p_i = 1$ if farm i is a contract farm; and $p_i = 0$ otherwise. Then we first use the probit model to estimate a selection model specified as $I_i^* = \delta Z_i + \varepsilon_i$, where I_i^* is a latent index capturing how farms choose between contract and noncontract farming; specifically farm i would choose contract farming ($p_i = 1$) if $I_i^* > 0$ and noncontract farming ($p_i = 0$) if otherwise. Z_i indicates farms' characteristics that affect the probability of their choices between contract and noncontract farming. Please see Chapter 3, this book for a detailed mathematical discussion.

The counterfactual results are given in Table 4.7. Had contract farms operated like a noncontract farm, their counterfactual profits would (on average) have been 31% lower than their actual profits; the differences are 49% and 21%, respectively, for contract farms in the North and Northeast. Conversely, had noncontract farms operated like a contract farm, their counterfactual profits would have been 47% higher than their actual profits; the differences are 9.4% (significant at the 10% level) in the North and 72% in the Northeast. These results clarify that the observed higher profitability in contract farming is not simply because of contract farming attracting the more profitable farms; rather, it is evidence supporting the hypothesis that contract farming tends to be more profitable than noncontract farming.

Table 4.7 Counterfactual versus Actual Profits

Profit	All		North		Northeast	
	Profit difference (%)	p-value	Profit difference (%)	p-value	Profit difference (%)	p-value
Contract counterfactual vs. Contract actual	-31.4	0.0000	-48.8	0.0000	-21.1%	0.0059
Noncontract counterfactual vs. Noncontract actual	47.4	0.0000	9.4	0.0957	71.8%	0.0000

Source: Authors' calculations.

4.3.1 Results: Comparative Profit Efficiency

Here we test the second hypothesis that “contract rice farmers are more profit-efficient than noncontract rice farmers for comparable scales of operation.” Table 4.8 shows the profit efficiency, actual profit, and profit loss per rai for contract and noncontract farms by region. Profits here are after deducting cash costs only from sales revenue. Profit loss is defined as the amount of unrealized profit due to inefficiency and can be calculated as the difference between maximum possible profit (i.e., profit on the profit frontier) for each farm and its actual profit.⁷

⁷ Profit efficiency reported is an index adjusted by including nine negative profit observations that were dropped from the estimation. The profit efficiency measure PE_i , which measures the ratio of a farm's actual profit to its maximum attainable profit, is not well defined when actual profits are negative. Since all the cases of negative profits are noncontract farms, excluding them would lead to biased results. Therefore, we apply the following measure of the profit efficiency of farms with negative actual profits. We first calculate the absolute value of profit loss of each of the nine negative profit farms compared to its estimated maximum attainable profit; let us denote such profit losses as $\Delta\pi_i$. Then, the profit efficiency of say farm i among these nine negative-profit farms is measured by $-\Delta\pi_i / \max(\Delta\pi_i)$, where $\max(\Delta\pi_i)$ represents the greatest profit loss among these nine farms. Under this profit efficiency measure, the profit efficiency score of a farm with negative profits would be negative and at the range of $[-1, 0)$. The one with the largest profit loss would have profit efficiency score of -1 ; and the closer a farm's negative profit efficiency is to zero, the greater its profit efficiency score would be compared to other farms with negative

The estimated mean profit efficiency score for the entire sample farms is 0.68. In other words, significant profit inefficiency occurred among the sample rice farms in Thailand and farms could increase their profit by 32% or 842 baht per rai by improving their efficiency.

As shown in Table 4.8, farmers in the North, where new land was brought into production, exhibited significantly higher profit efficiency than farmers working on the more degraded land of the Northeast, with a mean efficiency of 0.76 versus 0.63. Overall, contract farmers were significantly more profit-efficient than noncontract farmers, with a mean profit efficiency of 0.72 versus 0.64. This is also true for farmers in the Northeast where contract farmers are found to be significantly more profit-efficient than noncontract farmers (0.69 vs. 0.56). However, the efficiency scores of contract and noncontract farmers in the North were virtually the same on average, although the scores were more diverse among the noncontract farmers.

Table 4.8 Profit Efficiency of Contract versus Noncontract Rice Farmers

	N	Actual Profit (baht/rai)	Profit Loss (baht/rai)	Profit Efficiency Index
All	443	1,721	842	0.68
Contract	222	2,072	906	0.72
Noncontract	221	1,369	778	0.64
p-value		0.0000	0.0388	0.0032
North	168	1,847	650	0.76
Contract	83	2,001	727	0.76
Noncontract	85	1,697	575	0.76
p-value		0.0047	0.0934	0.9916
Northeast	275	1,644	960	0.63
Contract	139	2,114	1,014	0.69
Noncontract	136	1,163	905	0.56
p-value		0.0000	0.1769	0.0002

N = sample size.

Source: Authors' calculations.

actual profits. That farms with positive (or negative) actual profits have positive (or negative) profit efficiency scores implies that farms with negative actual profits must be less efficient than those with positive profits. This makes sense because farms with negative profits have lost more than whatever attainable profits they may have. Considering that we have used the least efficient farm as a benchmark to index the profit efficiency of farms with negative profits, we adjust the efficiency measure for positive profit farms accordingly by using $PE_i / \max(PE_i)$ to measure farm i 's efficiency. In sum, the adjusted profit efficiency scores are in the range of $[-1, 1]$. Farms with positive actual profits have positive profit efficiency scores, while farms with negative profits with negative scores. The greater a farm's score is, the more profit-efficient it is.

Table 4.9 Profit Efficiency by Farm Size

Farm Size	0–5 rai	6–10 rai	11–20 rai	>20 rai
All Farms				
Actual profit (per rai)	1,719 ^a	1,744 ^a	1,723 ^a	1,646 ^a
Profit loss (per rai)	821 ^b	774 ^b	850 ^b	1,067 ^a
Profit efficiency	0.69 ^a	0.70 ^a	0.67 ^a	0.64 ^a
Noncontract Farms				
Actual profit (per rai)	1,374 ^a	1,413 ^a	1,337 ^a	1,276 ^a
Profit loss (per rai)	801 ^a	762 ^a	764 ^a	818 ^a
Profit efficiency	0.64 ^a	0.65 ^a	0.62 ^a	0.64 ^a
Contract Farms				
Actual profit (per rai)	2,432 ^a	2,076 ^{a,b}	2,021 ^b	1,866 ^b
Profit loss (per rai)	862 ^b	786 ^b	916 ^b	1,215 ^a
Profit efficiency	0.78 ^a	0.75 ^a	0.70 ^{a,b}	0.64 ^b
p-value of profit efficiency between contract and noncontract farmers	0.0276	0.0325	0.1351	0.9902

Note: Similar superscript letters across farm size denote homogeneous subsets using the Duncan's multiple range test at the 5% level of significance.

Source: Authors' calculations.

Table 4.9 shows the profit efficiency across different farm sizes for contract and noncontract farmers. Similar to profitability, contract farmers had higher profit efficiency for all farm sizes except those greater than 20 rai. Contract farmers appear to show a slight tendency to decreasing profit efficiency for larger farm sizes, while noncontract farmers are more homogeneous across all farm sizes. Similar to the profitability, comparison by farm size, with respect to profit efficiency, contract farming does not seem to be biased against smaller farms.

Table 4.10 shows profit efficiency among the different groups of organic farms we have identified. Farmers with a longer history and more experience in organic farming (the "certified" group) appear to be more profit-efficient, as well as more profitable. However, multiple range tests show that all three groups of organic farmers in the North exhibited similar profit efficiency as well as profitability. In fact, in terms of profit efficiency, they were not different from the conventional noncontract farmers. In the Northeast, profit efficiency was not statistically different between the certified and transitory groups, although it was higher for these than for the initial organic group, whose efficiency was statistically similar to that of conventional noncontract farmers.

Table 4.10 Profit Efficiency by Different Stages of Organic Farming

	Certified Organic	Transitional Organic	Initial Organic	All Organic	Conventional
All Farms					
Actual profit (per rai)	2,428 ^a	1,901 ^b	1,752 ^b	2,072	1,369
Profit loss (per rai)	956 ^a	904 ^a	790 ^a	906	778 ^a
Profit efficiency	0.75 ^a	0.71 ^b	0.70 ^{ab}	0.72	0.64 ^b
North					
Actual profit (per rai)	2,018 ^a	2,042 ^a	1,927 ^a	2,001	1,697 ^a
Profit loss (per rai)	745 ^a	691 ^a	727 ^a	727	575 ^a
Profit efficiency	0.77 ^a	0.77 ^a	0.75 ^a	0.76	0.76 ^a
Northeast					
Actual profit (per rai)	2,849 ^a	1,867 ^b	1,416 ^c	2,114	1,163 ^c
Profit loss (per rai)	1,172 ^a	955 ^a	909 ^a	1,014	905 ^a
Profit efficiency	0.73 ^a	0.69 ^{a,b}	0.60 ^{a,b}	0.69	0.56 ^b

Note: Similar superscript letters across groups denote homogeneous subsets using the Duncan's multiple range test at the 5% level of significance.

Source: Authors' calculations.

4.3.2 Counterfactual Simulation for Profit Efficiency

Similar to the case of the actual-counterfactual profitability comparison, the difference in profit efficiency between contract and noncontract farming can also be evaluated by comparing actual and counterfactual efficiency. The methodology is similar to that used in estimating the counterfactual profitability. To estimate the counterfactual efficiency of a contract farm (i.e., its profit efficiency when hypothetically operating like a noncontract farm), the first step is to use the estimated profit frontier of noncontract farming to estimate the maximum profit the contract farm would have obtained had it produced like a noncontract farm with 100% efficiency.⁸ The second step is to use its hypothetical profit estimated from the counterfactual profit simulation to represent its counterfactual profit in noncontract farming. Then the difference between this counterfactual profit and the counterfactual frontier can be used to measure the farm's counterfactual efficiency. The counterfactual efficiency of a noncontract farm can be estimated similarly.

⁸ Similar to the estimation of counterfactual profits, we use the rice prices of noncontract farms to simulate contract farms' counterfactual rice prices.

Table 4.11 shows that contract farms in the entire sample would not have had very different counterfactual efficiency from their actual efficiency (69% vs. 70%) had they operated like a noncontract farm. This mainly reflects the situation in the Northeast, while contract farms in the North would have reduced their efficiency from 74% to 68% by counterfactually operating like a noncontract farm. With respect to the noncontract farms, generally for the entire sample, noncontract farms would have had a slightly higher counterfactual than actual efficiency (69% vs. 66%), and the difference is statistically significant at 10%. Again, this mainly reflects the situation in the Northeast (68% vs. 59%), while surprisingly the noncontract farms in the North would have had lower counterfactual efficiency than their actual efficiency (69% vs. 77%).

Table 4.11 Counterfactual vs. Actual Efficiency

Counterfactual vs. actual ¹	Average Profit Efficiency ²		
	Entire	North	Northeast
Contract farming			
Contract counterfactual	0.6879	0.6798	0.6928
Contract actual	0.6988	0.7409	0.6736
p-value	0.4965	0.0326	0.3096
Noncontract farming			
Noncontract counterfactual	0.6854	0.6873	0.6841
Noncontract actual	0.6596	0.7658	0.5913
p-value	0.1284	0.0009	0.0000

Notes:

¹ Total of 222 contract farms (83 in the North, 139 in the Northeast) and 212 noncontract farms (83 North, 129 Northeast).

² Efficiency scores are slightly different from those reported in the previous table that includes the nine noncontract farms with negative profits (see footnote 6).

Source: Authors' calculations.

In summary, the results from the counterfactual efficiency estimations are mixed and do not generally support the hypothesis that contract farming enhances profit efficiency. Indeed, the efficiency patterns appear to be different between the North and Northeast, perhaps due to different contract management systems and different land endowments.

4.4 CONCLUSIONS

The results of the empirical analysis lend credence to the contention that contract farming can be an effective institutional mechanism to

reduce transaction costs faced by small-scale, poor rice farmers and hence increase profitability and reduce rural poverty. Our results show that for the sample, contract rice farmers are more profitable than noncontract farmers by a significant margin. This is also true for each of the two regions in the sample. This profitability gap holds for alternative definitions of profitability and for all scales of operation. In terms of scale of operation, there is no evidence that contract farming is biased against small farmers and profits per unit of land decline with farm size, being highest for farms below 5 rai. Counterfactual simulations suggest this is not due to selection bias with the more profitable farms shifting to contracting arrangements.

There is significant profit inefficiency among the sample rice farmers in Thailand. Overall, rice farmers in Thailand could increase their profit by more than 30%. Again, overall, the efficiency losses are greater for noncontract farms, although there is only a significant difference in the Northeast, where land is significantly more degraded than in the North. Counterfactual simulations indicate that only in the Northeast would shifting to contract farming raise efficiency amongst noncontract farms. Farm size seems to have little impact on profit efficiency, although contract farms below 5 rai show higher efficiency than larger farmers.

The major factor driving these results appears to be the higher prices received by contract farmers (rather than by higher yields, for example). These higher prices are, in turn, due to the fact that contract farmers (particularly the NGO-based fair trade network operation in the Northeast) are growing high-quality organic rice that commands a premium price. As noted above, the analysis does not allow us to disentangle the effects of contracting arrangements from the use of organic farming technology. However, as a group, the well-established ("certified") organic farmers show considerably higher profitability than other contract farmers in the Northeast. In the North, where organic practices are less strictly enforced in the sample farms, there seems to be no significant difference between the profitability of the permanent, transitional, and initial organic groups, even though the latter two continue to use some chemicals and pesticides. All organic groups in both regions show a significantly higher profitability than noncontract, conventional farmers when we measure profits by deducting noncash costs ("profits over total variable costs").

With respect to the development of organic farming, the results from the present study show a distinctive development path in the different parts of the country. In Northeast Thailand where farmers have converted from

conventional chemical to organic farming on degraded land, profitability initially is relatively low (although still higher than those in similar, noncontract conventional farms) and increases with the number of years of organic operation. In other words, during the transition years, profits are low and as ecosystems restore themselves, the farms become more profitable and profit-efficient. In Northern Thailand, on the other hand, where new marginal land was brought into organic production, this pattern of increasing profit and profit efficiency over the years is not found, although profits are higher than conventional farms. Since farms in the northern region are on less degraded land than are farms in the Northeast, initial and transitional profitability from partial organic agriculture is much higher in the North than in the Northeast; and conventional rice farming also generates considerably higher profitability there than in the Northeast. These profitability figures simply reflect the market price value of rice output and if the definition of benefits were widened to include the potential environmental (avoidance of pollution from agrochemicals leaching) and health benefits (farmers not exposed to pesticides) of organic farming, the economic returns to organic farming are likely to be even greater.

This analysis suggests that a combination of contract and organic farming has been effective in enhancing the profitability and to some extent, the efficiency of small-scale rice farmers in Thailand. Particularly in the case of provinces in Northeast Thailand where the majority of the poor resides and where the green revolution has not been effective in addressing poverty and degraded ecosystems, contract farming of organic rice is shown to be an effective means of raising incomes and by implication addressing rural poverty. There are lessons here for Cambodia and the Lao PDR.

Appendix 1

Mathematical Description of the Profit Frontier Model

The estimation of profit efficiency requires the specification and estimation of the respective profit frontier. Consistent with much of the profit efficiency literature in agriculture, a single-output translog profit frontier is used because of its flexibility in parameter estimation when it is not desirable to impose rigid assumptions about substitution relations among inputs and factors in the model specification. The translog functional form to be estimated is as follows:

$$\ln \pi = \beta_0 + \sum_{i=1}^6 \beta_i \ln P_i + \frac{1}{2} \sum_{i=1}^6 \sum_{j=1}^6 \beta_{ij} \ln P_i \ln P_j + \sum_{i=1}^6 \sum_{k=1}^2 \phi_{ik} \ln P_i \ln X_k + \sum_{k=1}^2 \alpha_k \ln X_k + \frac{1}{2} \sum_{k=1}^2 \sum_{l=1}^2 \alpha_{kl} \ln X_k \ln X_l + v - u \quad (1)$$

where π denotes the normalized variable profit defined as gross revenue less total cash cost of variable inputs normalized by the price of rice. P_i denotes the normalized input price (again divided by price of rice) of the i^{th} variable input where $i = 1$ for seed, 2 for hired labor, 3 for chemical fertilizer, 4 for organic fertilizer, 5 for machinery power, and 6 for fuel.⁹ X_k denotes the quantity of the two fixed inputs where $k = 1$ for land and 2 for capital assets. v is the two-side random error and u is the non-negative random inefficiency term. β , α , and ϕ are parameters to be estimated.

Following Battese and Coelli (1995), we assumed u_i are independently distributed and truncations (at zero) of the normal distribution with mean, $\mu = Z_i \delta$, and variance, $\sigma_u^2 [1 - N(\mu, \sigma_u^2)]$, where Z_i is a vector of observable farm-specific variables hypothesized to have an influence on profit inefficiencies and δ is a vector of unknown parameters to be estimated. Thus, μ can be specified as follows:

$$\mu = \delta_0 + \sum_{m=1}^{11} \delta_m Z_m \quad (2)$$

where Z_m 's are 11 farm-specific characteristics representing different levels of transaction costs faced by each farm thought to affect relative inefficiency. They include demographic characteristics of household head, farm characteristics and endowments, and production practices.

⁹ We do not include the price of pesticide/herbicide in the specification because only a few organic farms and one third of conventional farms in the sample utilized it. Furthermore, expenditures on pesticides and herbicides constituted only a very small portion (less than 2%) of the total variable cash costs of farms that do use them.

The four farm characteristics and endowments variables are (1) a regional dummy where $Z_1 = 1$ for North and 0 for Northeast;¹⁰ (2) farm size (rai); (3) a dummy variable for land ownership, $Z_4 = 1$ if land is owned and 0 otherwise;¹¹ and (4) rice income in total agricultural income (%). The four demographic characteristics of household head are (5) experience in fragrant rice farming (years); (6) level of formal education of household head (years); (7) age of household head (years); and (8) nonagricultural income in total household income (%). The three general production practices variables are (9) amount of own labor (in % of total labor); (10) amount of own organic fertilizer (in % of total organic fertilizer); and (11) amount of own seed (in % of total seed).

Since the translog functional form requires logarithmic transformation of the variables and hence cannot handle observations with negative and zero profits. There are several possible remedies to this problem but none is universally acceptable in all situations. The possible solutions are (1) drop all negative and zero observations; (2) add a constant for each observation of the profit variable such that profit for each farm is positive; and (3) use a different functional form. In our case where the magnitude of the most negative profit in the sample is very large and thus the resulting bias from a nonlinear transformation of the data is rather unacceptable. Therefore, solution (2) is deemed inappropriate in the present situation.

The frontier module of Stata version 8 is used to estimate the above specified profit frontiers. The frontier module estimates all the unknown parameters, α , β , ϕ , and δ of the profit frontier and the inefficiency effects model simultaneously by maximum likelihood method. The likelihood function is expressed in terms of the variance parameters $\sigma^2 = \sigma_v^2 + \sigma_u^2$ and $\gamma = \sigma_u^2 / \sigma^2$.

Estimation Results

Appendix Table A1 shows the maximum likelihood estimates of the specified contract and non-contract profit frontiers and the inefficiency effects model as expressed in equations (1) and (2), respectively. As indicated by the Wald χ^2 , the stochastic frontier estimation with inefficiency effects is statistically significant for both contract and non-contract farms, suggesting that the model can explain the profit variations among these two types of farms relative to their respective profit frontiers.

¹⁰ The regional dummy is excluded in the estimation for contract farms because of convergence difficulty with the maximum likelihood estimation process.

¹¹ Farms with more than 50% of lands owned are considered an owners farm; those with less than 50% owned are a rented farm.

Table A1 Maximum Likelihood Estimates of Stochastic Profit Frontier and Inefficiency Effects Model (Contract vs. Noncontract)

Variables	Parameters	Contract Farming		Noncontract Farming	
		Coefficients	p-value	Coefficients	p-value
Profit function					
Constant	β_0	3.3419	0.170	6.6895	0.030
P ₁	β_1	1.3370	0.413	2.4983	0.166
P ₂	β_2	1.2305	0.060	−1.0222	0.426
P ₃	β_3	−2.7236	0.328	−2.5588	0.497
P ₄	β_4	−0.6807	0.117	0.5404	0.473
P ₅	β_5	0.0559	0.858	0.8985	0.021
P ₆	β_6	0.8132	0.068	2.3511	0.001
0.5(P ₁ ×P ₁)	β_{11}	−2.2633	0.035	−0.5369	0.446
0.5(P ₂ ×P ₂)	β_{22}	−0.0005	0.993	0.0668	0.767
0.5(P ₃ ×P ₃)	β_{33}	−3.1243	0.315	0.2065	0.939
0.5(P ₄ ×P ₄)	β_{44}	0.0141	0.748	−0.1091	0.206
0.5(P ₅ ×P ₅)	β_{55}	0.0200	0.508	−0.1083	0.051
0.5(P ₆ ×P ₆)	β_{66}	−0.0074	0.834	−0.0128	0.875
P ₁ ×P ₂	β_{12}	0.3962	0.117	−0.2503	0.604
P ₁ ×P ₃	β_{13}	1.4277	0.418	−0.6218	0.602
P ₁ ×P ₄	β_{14}	0.1136	0.583	0.1784	0.287
P ₁ ×P ₅	β_{15}	−0.0069	0.968	0.0843	0.444
P ₁ ×P ₆	β_{16}	0.0786	0.681	−0.1616	0.263
P ₂ ×P ₃	β_{23}	−1.2817	0.010	0.3793	0.613
P ₂ ×P ₄	β_{24}	0.2563	0.002	−0.4536	0.015
P ₂ ×P ₅	β_{25}	−0.1970	0.000	−0.0162	0.854
P ₂ ×P ₆	β_{26}	−0.0320	0.474	−0.3677	0.039
P ₃ ×P ₄	β_{34}	−0.3170	0.304	0.1110	0.838
P ₃ ×P ₅	β_{35}	0.2462	0.312	−0.2049	0.478
P ₃ ×P ₆	β_{36}	−0.2264	0.459	0.6684	0.127
P ₄ ×P ₅	β_{45}	−0.0170	0.580	0.0823	0.171

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Table A1 *continued*

Variables	Parameters	Contract Farming		Noncontract Farming	
		Coefficients	p-value	Coefficients	p-value
$P_4 \times P_6$	β_{46}	0.0218	0.489	-0.0383	0.658
$P_5 \times P_6$	β_{56}	-0.0646	0.069	-0.0597	0.220
$P_1 \times X_1$	ϕ_{11}	0.7438	0.022	-0.4428	0.019
$P_2 \times X_1$	ϕ_{21}	-0.1364	0.110	0.1294	0.448
$P_3 \times X_1$	ϕ_{31}	-0.4495	0.297	-0.3686	0.481
$P_4 \times X_1$	ϕ_{41}	-0.0053	0.929	-0.0023	0.978
$P_5 \times X_1$	ϕ_{51}	0.0401	0.289	0.0178	0.754
$P_6 \times X_1$	ϕ_{61}	-0.0931	0.109	0.0389	0.653
$P_1 \times X_2$	ϕ_{12}	-0.3510	0.008	-0.0302	0.789
$P_2 \times X_2$	ϕ_{22}	-0.0126	0.838	-0.0236	0.766
$P_3 \times X_2$	ϕ_{32}	0.5717	0.002	0.3439	0.168
$P_4 \times X_2$	ϕ_{42}	-0.0012	0.971	0.0138	0.806
$P_5 \times X_2$	ϕ_{52}	0.0334	0.118	-0.0454	0.160
$P_6 \times X_2$	ϕ_{62}	-0.0343	0.368	-0.1228	0.011
X_1	α_1	0.3427	0.469	0.4732	0.526
X_2	α_2	0.2455	0.428	0.0147	0.971
$0.5(X_1 \times X_1)$	α_{11}	-0.1354	0.198	-0.1430	0.263
$0.5(X_2 \times X_2)$	α_{22}	-0.0391	0.107	0.0060	0.861
$X_1 \times X_2$	α_{12}	0.0828	0.065	0.0629	0.170
Inefficiency					
Constant	δ_0	-0.3186	0.618	1.4739	0.403
Region (North = 1; Northeast = 0)	δ_1	n.a.*	n.a.*	-2.8577	0.059
Land size (rai)	δ_2	0.0104	0.376	0.0467	0.327
Land ownership (own = 1; rent = 0)	δ_3	-0.3079	0.336	0.5608	0.521

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Table A1 *continued*

Variables	Parameters	Contract Farming		Noncontract Farming	
		Coefficients	p-value	Coefficients	p-value
Rice in agriculture income (%)	δ_4	0.0014	0.665	−0.0253	0.061
Experience in fragrant rice farming (years)	δ_5	−0.0177	0.063	0.0138	0.612
Education (years)	δ_6	0.0410	0.443	−0.1713	0.410
Age (years)	δ_7	0.0171	0.069	0.0066	0.769
Nonagricultural in total income (%)	δ_8	0.6731	0.128	1.5857	0.135
Own labor ratio (%)	δ_9	−1.1720	0.020	−3.7558	0.036
Own organic fertilizer ratio (%)	δ_{10}	0.2666	0.247	−0.4208	0.451
Own seed ratio (%)	δ_{11}	0.1923	0.267	0.7608	0.228
Variance parameters					
Wald χ^2 (44)	χ^2	892.33		861.85	
$\sigma^2 = \sigma_u^2 + \sigma_v^2$	σ^2	0.3130		1.3707	
$\gamma = \sigma_u^2 / \sigma^2$	γ	0.9595		0.9832	
Log likelihood		−46.28		−103.98	

P_1 = seed price, P_2 = hired labor wage, P_3 = chemical fertilizer price, P_4 = organic fertilizer price, P_5 = machinery price, P_6 = fuel price.

Notes:

¹ All prices are normalized by the output price and in log form. X_1 = land; X_2 = capital.

² Both fixed inputs are in log form.

³ The region dummy is not included in the estimation for the contract farming.

Source: Authors' calculations.

**Table A2 Summary Statistics of Variables Used in Frontier Estimation
(contract farms)¹**

Variable	Unit	Mean	SD	Min	Max
Output, profit, prices, and fixed inputs					
Rice output	kg	5,134	3,444	400	22,500
Variable profit (gross revenue less total cash cost)	baht/farm	26,692	18,207	2,495	90,881
Hired labor wage	baht/person/day	195	365	21	4,600
Rice price	baht/kg	7.37	1.39	5	10
Seed price	baht/kg	9.88	1.48	6	15
Chemical fertilizer price	baht/kg	7.04	0.18	6	8
Organic fertilizer price	baht/kg	2.08	3.17	0.15	28
Fuel price	baht/rai	5.76	5.09	0.10	33
Machinery power	baht/rai	213	211	5	1,010
Land	rai	14	8.58	1	60
Capital	bath	53,265	67,557	204	543,717
Farm-specific variables					
Farm characteristics and endowments					
Regional dummy (North = 1, Northeast = 0)	0/1				
Farm size	rai	0.37	0.48	0	1
Land ownership (own=1, rent=0) ²	0/1	14	8.58	1	60
Rice income total agricultural income	%	0.94	0.24	0	1
Demographic and other characteristics of household head					
Experience in fragrant rice farming	years	12	9.82	1	50
Level of formal education	years	2.86	1.38	1	8
Age	years	49	11	30	76
Nonagricultural income in total household income	%	11	20	0	92
General production practices					
Amount of own labor	%	72	26	9	100
Amount of own organic fertilizer	%	47	39	0	100
Amount of own seed	%	55	50	0	100

kg = kilogram, SD = standard deviation.

Notes:

¹ Among the 223 contract farms in the sample, only 222 are used in the regression, with one outlier excluded.

² Farms with more than 50% of lands owned are considered an “owner’s farm”; those with less than 50% of lands owned are considered a “rented farm.”

Source: Authors’ calculations.

**Table A3 Summary Statistics of Variables Used in Frontier Estimation
(contract farms)¹**

Variable	Unit	Mean	SD	Min	Max
Output, profit, prices, and fixed inputs:					
Rice output	kg	4,106	3,050	360	25,000
Variable profit (Gross revenue less total cash cost)	baht/farm	15,114	13,182	180	107,350
Hired labor wage	baht/person/day	144	87	36	952
Rice price	baht/kg	5.94	0.72	4	12
Seed price	baht/kg	9.66	2.45	5	20
Chemical fertilizer price	baht/kg	7.02	0.47	5	9
Organic fertilizer price	baht/kg	1.29	1.88	0.13	25
Fuel price	baht/rai	6.12	4.46	0.21	32
Machinery power	baht/rai	237	209	5	1,159
Land	rai	11	7.36	1	50
Capital	bath	34,115	44,882	235	366,981
Farm-specific variables					
Farm characteristics and endowments					
Regional dummy (North = 1, Northeast = 0)	0/1	0.39	0.49	0	1
Farm size	Rai	11	7.36	1	50
Land ownership (own = 1, rent = 0) ²	0/1	0.86	0.35	0	1
Rice income total agricultural income	%	59	27	7	100
Demographic and other characteristics of household head					
Experience in fragrant rice farming	years	13	9.34	1	50
Level of formal education	years	2.38	1.06	1	8
Age	years	51	11	29	85
Nonagricultural income in total household income	%	12	23	0	89
General production practices					
Amount of own labor	%	74	27	8	100
Amount of own organic fertilizer	%	35	44	0	100
Amount of own seed	%	57	49	0	100

kg = kilogram, SD = standard deviation.

Notes:

¹ Only 212 among the 222 noncontract farms in the sample are used in the regression; one outlier is excluded and another 9 farms are excluded as they have negative profits.

² Farms with more than 50% of lands owned considered an “owner’s farm”; those with less than 50% of lands owned considered a “rented farm.”

Source: Authors’ calculations.

Table A4 Costs and Returns of Rice Farming in Thailand

	Total Sample	Contract/Organic Farms				Noncontract/ Conventional Farms	p-value ¹
		Permanent	Transition	Initial	Total		
North (No. of farms)	168	41	21	21	83	85	
Profits over total variable costs							
Total profit (baht)	13,680	17,437 ^{ab}	21,015 ^a	15,754 ^{a,b}	17,916	9,543 ^b	0.0009
Profit per unit of land (baht/rai)	980	1,166 ^a	1,309 ^a	1,291 ^a	1,234	731 ^b	0.0000
Profit per unit of production (baht/rai)	1.98	2.34 ^a	2.68 ^a	2.61 ^a	2.50	1.48 ^b	0.0000
Profit over cash costs							
Total profit (baht)	21,800	27,377 ^a	30,731 ^a	22,371 ^{ab}	26,959	16,762 ^b	0.0001
Profit per unit of land (baht/rai)	1,847	2,018 ^a	2,042 ^a	1,927 ^a	2,001	1,697 ^a	0.0047
Profit per unit of production (baht/rai)	3.90	4.23 ^a	4.23 ^a	4.07 ^a	4.19	3.62 ^a	0.0018
Production/ yield (kg/rai)	464	472 ^a	477 ^a	461 ^a	470	458 ^a	0.3899
Price of rice (baht/kg)	6.26	6.59 ^a	6.45 ^a	6.38 ^a	6.50	6.02 ^b	0.0000
Cash costs (baht/rai) ²	1,061	1,095 ^a	1,034 ^a	1,022 ^a	1,061	1,060 ^a	0.9867
Labor	406	440 ^a	368 ^a	349 ^a	399	414 ^a	0.7706
Seed	57	44 ^a	43 ^a	76 ^a	51	62 ^a	0.3598
Chemical fertilizer	136	0 ^d	85 ^c	138 ^b	56	214 ^a	0.0000
Organic fertilizer	95	217 ^a	161 ^a	96 ^b	172	19 ^c	0.0000
Pesticides and herbicides	5.61	0 ^c	3.51 ^{a,b}	2.38 ^{a,b}	1.49	9.63 ^a	0.0016
Fuel	93	98 ^a	79	115 ^a	98	88 ^a	0.4546
Machinery power	267	295 ^a	295 ^a	246 ^a	282	253 ^a	0.4328
Noncash costs (baht/rai)	868	852 ^a	733 ^a	636 ^a	767	966 ^a	0.0375

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Table A4 *continued*

	Total Sample	Contract/Organic Farms				Noncontract/ Conventional Farms	p-value ¹
		Permanent	Transition	Initial	Total		
Labor	774	645 ^{ab}	620 ^{ab}	574 ^b	621	923 ^a	0.0014
Seed	42	57 ^a	51 ^a	33 ^a	50	34 ^a	0.0972
Organic fertilizer	52	150 ^a	62 ^b	28 ^b	97	8.75 ^b	0.0011
Total variable costs (baht/rai)	1,928	1,946 ^{ab}	1,768 ^{ab}	1,658 ^b	1,828	2,026 ^a	0.0401
Farm capital assets (baht/farm)	57,322	75,494 ^a	79,081 ^a	63,113 ^a	73,269	41,751 ^a	0.0039
Farm capital assets (baht/rai)	16,378	18,853 ^{ab}	17,956 ^{ab}	25,956	20,423	12,427 ^b	0.0073
Northeast (No. of farms)	275	40	88	11	139	136	
Profits over total variable costs							
Total profit (baht)	9,983	22,606 ^a	13,071 ^b	5,531 ^c	15,218	4,633 ^c	0.0000
Profit per unit of land (baht/rai)	690	1,800 ^a	833 ^a	654 ^{b,c}	1,098	273 ^c	0.0000
Profit per unit of production (baht/rai)	1.66	4.97 ^a	2.21 ^b	1.60 ^b	2.96	0.34 ^c	0.0000
Profit over cash costs							
Total profit (baht)	19,726	35,203 ^a	24,320 ^b	12,693 ^c	26,532	12,771 ^c	0.0000
Profit per unit of land (baht/rai)	1,644	2,849 ^a	1,867 ^b	1,416 ^c	2,114	1,163 ^c	0.0000
Profit per unit of production (baht/rai)	4.66	8.07 ^a	5.34 ^b	3.85 ^c	6.01	3.29 ^c	0.0000
Production/ yield (kg/rai)	346	353 ^a	347 ^a	350 ^a	349	342 ^a	0.5881
Price of rice (baht/kg)	6.89	10 ^a	7.14 ^b	6.29 ^c	7.89	5.87 ^d	0.0000
Cash costs (baht/rai)²	725	631 ^a	592 ^a	810 ^a	621	831 ^a	0.0006

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Table A4 *continued*

	Total Sample	Contract/Organic Farms				Noncontract/ Conventional Farms	p-value ¹
		Permanent	Transition	Initial	Total		
Labor	281	239 ^a	274 ^a	369 ^a	272	290 ^a	0.6599
Seed	16	2.40 ^a	17 ^a	14 ^a	13	18 ^a	0.1388
Chemical fertilizer	95	0 ^b	0 ^b	0 ^b	0	192 ^a	0.0000
Organic fertilizer	101	174 ^a	114 ^{a,b}	191 ^a	137	65 ^b	0.0000
Pesticides and herbicides	1.33	0.00 ^a	0.00 ^a	0.00 ^a	0	2.69 ^a	0.0001
Fuel	37	49 ^{a,b}	33 ^b	69 ^a	40	34 ^b	0.2596
Machinery power	193	166 ^a	154 ^a	167 ^a	158	228 ^a	0.0079
Noncash costs (baht/rai)	954	1,049 ^a	1,033 ^a	761 ^a	1,016	890 ^a	0.0585
Labor	697	677 ^a	726 ^a	512 ^a	695	699 ^a	0.9387
Seed	58	69 ^b	39 ^b	107 ^a	53	63 ^b	0.1981
Organic fertilizer	199	303 ^a	269 ^a	142 ^b	269	127 ^b	0.0000
Total variable costs (baht/rai)	1,679	1,680 ^a	1,625 ^a	1,572 ^a	1,637	1,721 ^a	0.2746
Farm capital assets (baht/farm)	36,191	34,618 ^a	45,367 ^a	33,311 ^a	41,320	30,950 ^a	0.0628
Farm capital assets (baht/rai)	9,062	8,439 ^a	9,651 ^a	8,614 ^a	9,220	8,901 ^a	0.8257
Total	443	81	109	32	222	221	
Profit over variable costs							
Total profit (baht)	11,385	19,989 ^a	14,601 ^b	12,240 ^b	16,227	6,522 ^c	0.0000
Profit per unit of land (baht/rai)	800	1,479 ^a	925 ^b	1,072 ^b	1,149	449 ^c	0.0000
Profit per unit of production (baht/kg)	1.78	3.64 ^a	2.30 ^b	2.26 ^b	2.78	0.78 ^c	0.0000
Profit over cash costs							
Total profit (baht)	20,513	31,242 ^a	25,555 ^b	19,044 ^c	26,692	14,306 ^c	0.0000
Profit per unit of land (baht/rai)	1,721	2,428 ^a	1,901 ^b	1,752 ^b	2,072	1,369 ^c	0.0000

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Table A4 *continued*

	Total Sample	Contract/Organic Farms				Noncontract/ Conventional Farms	p-value ¹
		Permanent	Transition	Initial	Total		
Profit per unit of production (baht/kg)	4.37	6.13 ^a	5.13 ^b	4.00 ^c	5.33	3.41 ^c	0.0000
Production/ yield (kg/rai)	390	413 ^a	372 ^a	423 ^a	394	387 ^a	0.4828
Price of rice (baht/kg)	6.65	8.27 ^a	7.00 ^b	6.35 ^c	7.37	5.93 ^d	0.0000
Cash costs (baht/rai) ²	852	866 ^a	677 ^b	949 ^a	785	919 ^a	0.0053
Labor	328	341 ^a	292 ^a	356 ^a	319	338 ^a	0.5746
Seed	31	24 ^b	22 ^b	54 ^a	27	35 ^b	0.1303
Chemical fertilizer	111	0 ^c	16 ^c	91 ^b	21	201 ^a	0.0000
Organic fertilizer	99	196 ^a	123 ^b	128 ^b	150	47 ^c	0.0000
Pesticides and herbicides	2.95	0 ^b	0.68 ^b	1.56 ^b	0.56	5.36 ^a	0.0000
Fuel	59	74 ^{a,b}	42 ^c	99 ^a	62	55 ^{bc}	0.2916
Machinery power	221	231 ^a	181 ^a	219 ^a	205	238 ^a	0.1334
Noncash costs (baht/rai)	921	949 ^a	975 ^a	679 ^b	923	919 ^a	0.9461
Labor	726	661 ^{a,b}	705 ^{a,b}	553 ^c	667	785 ^a	0.0199
Seed	52	63 ^a	41 ^a	59 ^a	52	52 ^a	0.9319
Organic fertilizer	143	225 ^a	229 ^a	68 ^b	204	82 ^b	0.0000
Total variable costs (baht/rai)	1,773	1,815 ^a	1,653 ^a	1,628 ^a	1,708	1,838 ^a	0.0336
Farm capital assets (baht/farm)	44,205	55,309 ^a	51,863 ^a	52,869 ^a	53,265	35,104 ^a	0.0009
Farm capital assets (baht/rai)	11,836	13,710 ^b	11,251 ^b	19,995 ^a	13,409	10,257 ^b	0.0338

kg = kilogram.

Notes:

¹ p-values are for the respective tests of mean difference between contract farmers and noncontract farmers.

² Besides those listed in the table, cash costs also include certification fees for organic farms.

Similar superscript letters across organic groups denote homogeneous subsets using the Duncan's multiple range test at the 5% level of significance.

Source: Authors' calculations.

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5. Rice Contract Farming in the Lao PDR: Moving from Subsistence to Commercial Agriculture¹

Sununtar Setboonsarng, Adam Stefan, and PingSun Leung



5.1 INTRODUCTION

As globalization and market liberalization profoundly change global agricultural production, small farms in developing countries are at risk of being excluded from the opportunities for high-value production arising from the opening of regional and international markets. Small farms typically lack the resources, knowledge, and information to compete in increasingly integrated markets. They are hampered by imperfect market information and poor infrastructure, and have few links with buyers in the marketing chain. These disadvantages contribute significantly to the low incomes and poverty found in developing countries where small farms dominate the agriculture sector.

In the Lao People's Democratic Republic (Lao PDR), agriculture's share in the country's gross domestic product (GDP) has steadily declined, from 58% in 1990 (World Bank 2010) to 30% in 2010 (National Economic Research Institute 2011), while that of the industry sector has been trending upward in the last decades. Economic development has nearly halved the percentage of people living below the national poverty line, but poverty incidence is still disproportionately high in rural areas, particularly those without access to roads, at 45% compared to the national average of roughly 25% (World Bank 2010).

As the majority still live in the rural areas, agriculture continues to employ a greater proportion of the population. Rice cultivation is the single most important economic activity, accounting for half of all agricultural output and one-fifth of total GDP. Almost all of the country's agricultural output is produced on small family farms. The vast majority of farmers in the Lao PDR practice subsistence rice farming and lack access to the support necessary to improve their productivity and income. Although the enactment of the New Economic Mechanism in 1986 opened the country to international markets, low market integration remains the prevailing condition. Market access is limited due to poor infrastructure, insufficient

¹ First published as Setboonsarng, S., A. Stefan and P.S. Leung. 2008. "Rice Contract Farming in Lao PDR: Moving from Subsistence to Commercial Agriculture." ADBI Discussion Paper 90. Tokyo: Asian Development Bank Institute. Available: <http://www.adbi.org/files/dp90.rice.contract.farming.in.lao.pdr.pdf>

market information, and a regionally confined marketing system dominated by a limited number of traders (MPDF 2004).

To facilitate the transition from subsistence to a market-oriented economy, the government has encouraged foreign direct investment (FDI) by the private sector in rural areas. In areas where transport infrastructure has been put in place, FDI has flowed in to take advantage of the country's relatively abundant, fertile land, and low labor cost. One example of private sector investment that has proliferated in recent years is contract farming. The contracting firm (usually an agroprocessing or marketing firm) agrees to purchase a specific commodity at an agreed-upon price and time, while the farmer agrees to supply the contracted quantities at the specified quality standards. The rapid and widespread expansion of contract farming has prompted us to take a closer look at its benefits and costs to smallholders.

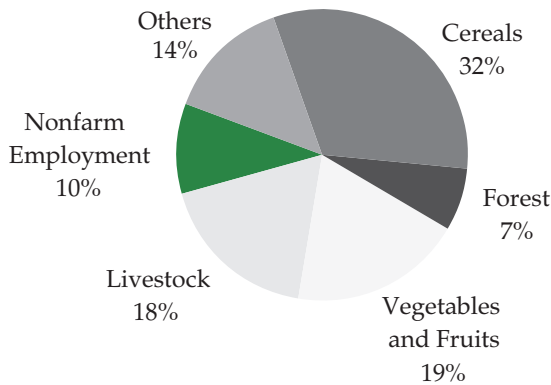
Using the case of Lao Arrowny Corporation, a Lao–Japanese joint venture that has contracted more than 2,000 farmers since 2002 to produce Japanese rice for export, this chapter provides a comprehensive comparison of contract rice farming households and noncontract rice farming households under similar agroecological and social conditions using propensity score matching comparison and endogenous switching regression models to determine if contract farms are more profitable than noncontract farms, and whether contract farming is biased toward more competitive farms.

5.2 PRODUCTION AND MARKETING IN THE LAO PDR

Crop production systems in the Lao PDR remain primarily subsistence-oriented, with minimal use of improved varieties, fertilizers, and pesticides. Although the use of modern inputs is increasing, their adoption has largely been confined to production in the Mekong River corridor (Schiller et al. 2006). Farmers are generally excluded from the growing markets for high-value crops due to the lack of extension mechanisms and credit provision systems. Adoption of new technologies by risk-averse subsistence farmers is also constrained by the absence of risk-sharing strategies.

In 2004, average annual productivity (agricultural GDP/agricultural population) was \$235 per worker, compared with \$148 in Cambodia, \$159 in Viet Nam, and \$413 in Thailand (FAO 2006). At the provincial level, however, there is a significant variation in agricultural productivity. While national average productivity (measured in terms of gross revenue from agriculture) is \$0.14 per hour worked, the provincial averages range from \$0.09 per hour worked in Saravane to \$0.26 in Xayabury and Bokeo

Figure 5.1 Average Sources of Rural Household Income in the Lao PDR



Lao PDR = Lao People's Democratic Republic.

Source: UNODC. 2004. Lao PDR Opium Survey.

(NSC 2004). The comparatively high productivity in Xayabury and Bokeo can be attributed to the prevalence of contract farming and cross-border exports in those provinces, suggesting the potential of market-oriented production to increase productivity and income. Overall, the border districts of the Lao PDR show stronger economic activity and have lower poverty headcounts than non-border districts (World Bank 2006).

The lack of a functional marketing system is a major barrier to improving the productivity of Lao agriculture. Agricultural marketing is generally on a small scale with short marketing channels. Only 5% of the country's total rice production (approximately 110,000 tons) is commercially marketed (MPDF 2004). The commercial trade in rice is dominated by a state-owned enterprise, the State Enterprise and Food Crop Promotion (SEFCP), which controls 70% of the market. The SEFCP has historically constrained the growth of trade and output growth by fixing the prices of food commodities (often below production costs) and restricting private-sector trade between provinces (ADB 2006).

Small farms typically sell paddy to traders who visit rural areas or deliver paddy to mills located along the main road or near larger towns for consumption or direct sale in the village. Due to the predominance of spot markets, prices are set by traders based on the previous season's price or production costs, and price fixing among traders is common. As a result, there is the widespread perception that traders are exploiting farmers (Oraboune and Nanthavongdouangsy 2006).

5.3 CONTRACT FARMING IN THE LAO PDR

Contract farming has spread rapidly in the Lao PDR in recent years. Growth in domestic demand for agricultural produce has been driven by urban expansion, providing new market opportunities for small farms, especially those located near urban centers. There is also increasing regional demand from the People's Republic of China (PRC), Thailand, and Viet Nam for specialty crops including hemp, mulberry paper, castor bean, Job's tears, and palm nut, all of which are produced in the Lao PDR.

Thailand, in particular, has actively pursued contract farming as an area for economic cooperation in the Mekong region. Under an initiative of the Association of Southeast Asian Nations (ASEAN) Free Trade Area (AFTA), for example, Thailand agreed to provide assistance to develop border areas in the Lao PDR for contract farming to meet the demand of its growing food industry (MPDF 2004). Thailand has also announced that it would allow tariff-free importation of all approved agricultural products produced under contract farming in Ayeyawady–Chao Phraya–Mekong Economic Cooperation Strategy (ACMECS)² member countries.

There is also significant export potential for niche products and organic products. Although small and medium-sized enterprises are marginalized by the advancing consolidation of multinational agribusinesses, certain niche markets remain competitive for small farms (UNDP/NSC 2006). Diversification of agricultural activities into these high-value markets can improve small farms' incomes.

Contracts can take a wide variety of forms, ranging from a simple verbal agreement between farmer and trader to a written contract that explicitly details the obligations of each party. However, the majority of contract farming ventures in the Lao PDR are informal arrangements between farmers and small traders that operate outside legal boundaries. Firms have reported losses due to farmers violating the contract to sell their crops on the market, while farmers have reported losses because the contracting firm did not share the cost of a failed crop or did not collect the produce after harvest. In such cases, there is no legal avenue for farmers or firms to recover losses (ADB 2007).

² This was announced at the Second ACMECS Summit held on 3 November 2005 in Bangkok, Thailand. ACMECS is a cooperation agreement among Cambodia, the Lao PDR, Myanmar, Thailand, and Viet Nam, which aims to promote balanced development in the Mekong region.

Nonetheless, a number of local and foreign private investors have established medium- to large-scale contract farming agreements with smallholder farmers:

Tea, Phongsaly Province. Tea contract farming in Phongsaly involves 520 households and covers a production area of approximately 400 hectares (ha). The contracts are signed between PRC traders and the provincial government, which organizes farmers to grow the tea for a predetermined price. The PRC investors provide seed and technical assistance on production and processing methods, and they purchase all of the tea from the farmers to sell in the PRC market.

Maize, Bokeo Province. Maize is produced under verbal contract with a Thai import firm by approximately 600 households with a total cultivation area of 1,136 ha. The firm supplies contracted farmers with inputs including seed, fertilizer, and credit. The maize is grown in accordance with government regulations.

Soybeans, Udomsay Province. Soybean production is organized by a United States (US)–Lao joint venture feed mill firm in several districts. The firm provides seed and technical assistance for production technology, yet offers a price slightly below market price. In 2004, many contracts were breached and the supply chain broken when PRC traders offered more competitive prices and purchased soybeans from the contracted farmers.

Maize, Luang Nam Tha Province. A US nongovernment organization (NGO) registered as a trading firm operates contract farming of maize in three districts without a formal contract. The NGO provides farmers with in-kind credit in the form of seed and purchases their produce at the end of the season. During its first 2 years of operation, the NGO did not encounter any breaches of contract; however, in 2003, PRC traders purchased all farmer output. The NGO did not possess the means to enforce the verbal contracts and lost the seed.

Sugar Cane, Phongsaly Province. Lao farmers produce sugar cane for a PRC sugar mill across the border. The buyers provide some seeds and fertilizer but do not offer a guaranteed price. At harvest, the dried sugar cane is weighed and the cost of inputs is subtracted from the sale price. Although the transaction is one-sided, additional farmers have shifted to sugar cane cultivation—without input support—to participate in the sales (UNDP/NSC 2006).

Sweet Corn, Vientiane Province. Lao Agro Industry Co. (LAI) is a Thai–Lao joint venture affiliated with Lampang Food Products, a Thai food processor and exporter. LAI has been operating in the Lao PDR since 1994, processing bamboo shoot, baby corn, mango, and sugar palm seed. LAI contracts households from the sweet corn farmer production and marketing group to supply sweet corn to its cannery. The company provides credit for seed and fertilizer, while the local government provides credit for land preparation. Although only 11 households on 3.5 ha were contracted in the 2006–2007 dry season, LAI is targeting a planting area of approximately 160 ha to produce 2,000 tons of sweet corn.

Horticulture, Bokeo Province. Thai processing firms organize contract farming of horticulture crops such as mustard cabbage in Bokeo Province. Information is not available on the number of participating households or land area under cultivation. Green bean production has largely been discontinued as farmers experienced negative health consequences due to high pesticide use; one farmer interviewed during a field visit reported a death in his family due to pesticide poisoning.

Rubber, Northern provinces. Para-rubber cultivation was introduced in Luang Namtha Province in the mid-1990s with assistance from the PRC. The rubber cultivation area in the Northern provinces has since expanded steadily due to growing demand from the PRC. Although large-scale concession areas currently account for the majority of rubber production, the government is promoting smallholder rubber production as a way of stabilizing shifting cultivation and increasing upland farmer income (Manivong and Cramb 2007).

5.4 CASE STUDY: CONTRACT RICE FARMING IN VIENTIANE PROVINCE

Established in 2002, Lao Arrowny Corporation is a joint venture between a Lao and a Japanese investor to produce organic Japanese rice for export to Japanese expatriates in Southeast Asia. The company received approval from the Ministry of Agriculture and Forestry to recruit small farms from an area covering 18,500 ha countrywide. As of 2004, the company had approximately 2,000 households with a total land area of 800 ha under contract.

The selection criteria for contract farms include (i) owning their own rice field; (ii) accepting fellow farmers as hardworking in order to become members of the farmers' association; and (iii) agreeing to not use chemical

fertilizers in the growing process. While the company markets the rice as “bio-organic rice,” it is not sold as certified organic rice. In fact, the company allows farmers to use a small amount of chemical fertilizers, up to 30 kilograms per hectare.

Contract farmers receive the premium price specified in the contract for growing organic rice, less the amount of credit used for inputs. The company supplies raw materials in the form of in-kind credit for seed and organic fertilizer (bat manure) and provides technical assistance. The team leader of the extension staff was a former government extension agent who received training in Japan under official development assistance.

Lao Arrowny, however, faces several challenges that reflect the early stage of private sector development in the Lao PDR. The supply of rice from farmers presently exceeds the company’s working capital for procurement and processing. The company lacks in-house processing capacity and incurs high transport costs to have the paddy processed in Thailand prior to third-country export. As a result, Lao Arrowny failed to meet the market demand in 2004, exporting only 540 tons of rice against potential demand for up to 10,000 tons.

Using a standard questionnaire, a farm survey was conducted in September 2004 with 585 farmers in Vientiane Province. The surveyed households include 332 contract farmers and 253 noncontract farmers in the same agroecological and socioeconomic settings. The surveyed villages are fertile, low-land rice growing villages located in Vientiane Municipality, immediately outside of the capital city of Vientiane. These areas have relatively good road access, public health service centers, and agriculture extension centers, including the Agricultural Promotion Bank (APB).

Rice is primarily grown under rain-fed production, although in some areas supplementary irrigation is available. These areas represent a farming system in transition from subsistence to commercial orientation, as traditional agriculture adapts to the emergence of new economic opportunities from increasing demand for crops and livestock from the Vientiane urban center. Farmers generally have more than one plot of rice land, growing certain varieties for home consumption (typically sticky rice) and other varieties for sale.

The following sections describe the socioeconomic characteristics and rice production systems of contract farming households and noncontract farming households.

5.5 HOUSEHOLD CHARACTERISTICS

5.5.1 Family Size and Land Size

On average, contract farmers have larger families and own more land. The average family size for contract farmers is 5.88 persons (4.52 adults) per household, greater than noncontract farmers' average of 5.61 persons (4.03 adults) per household. On average, a contract farming household owns 2.48 ha, compared with 1.72 ha for noncontract farmers (Table 5.1).

Table 5.1 Household Characteristics

Variables	Contract	Noncontract	p-value*
No. of family members	5.88	5.61	0.0853
No. of family members older than 16	4.52	4.03	0.0011
Percentage of females in family	49	49	0.8628
Total land (ha)	2.48	1.72	0.0002
No. of TVs	0.96	0.86	0.0038
No. of radios	0.23	0.19	0.3316
No. of hand tractors	0.61	0.46	0.0004
No. of plows	0.006	0.011	0.4683
No. of bikes	1.02	1.02	0.9798
No. of motorbikes	0.81	0.65	0.0155
Value of livestock (millions of kip)	6.22	4.83	0.0533
Monthly consumption expenditure per person (1,000 kip)	144	147	0.8592
Percentage of homegrown in consumption expenditure	36	38	0.3695
Credit total (1,000 kip)	446	191	0.0196
Income per adult from non-rice sources (1,000 kip)	2,401	2,334	0.7546
Income per adult from other crops (1,000 kip)	298	163	0.0848
Income per adult from animal sales (1,000 kip)	417	262	0.0039
Income per adult from off-farm activities (1,000 kip)	1,686	1,909	0.2428
Ratio of off-farm income in non-rice income (%)	67	77	0.0012
Ratio of handicrafts in off-farm income (%)	9	12	0.1767
Ratio of wage in off-farm income (%)	45	44	0.7825
Ratio of remittance in off-farm income (%)	6	8	0.2503
Ratio of other activities in off-farm income (%)	40	36	0.2887
Distance to farm-to-market road (km)	20.23	22.20	0.2224
Distance to highway (km)	7.54	8.61	0.1020

km = kilometer.

* p-value is the smallest level of significance for which we can reject the respective hypothesis test of difference in means between contract and noncontract farmers using the appropriate t-test.

Source: Survey data result 2004.

5.5.2 Household Economic Conditions

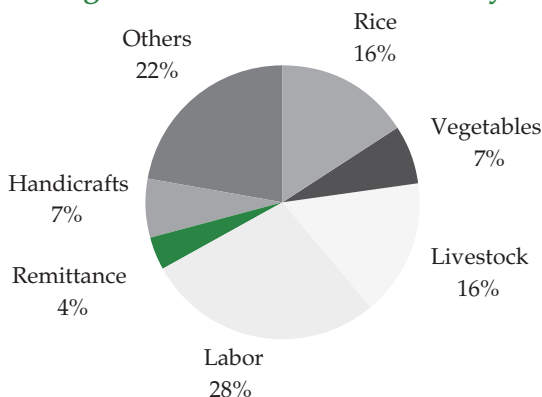
On average, contract and noncontract farmers have similar household economic conditions. Although contract farmers own more fixed assets than noncontract farmers, including televisions, tractors, motorbikes, and livestock, contract and noncontract households have similar monthly consumption expenditures (147,000 kip/person and 144,000 kip/person, respectively)³ and rely on homegrown products to a similar extent (36% and 38%, respectively). The average monthly consumption expenditure for both contract and noncontract households is slightly higher than average for Vientiane Province (NSC 2004).

5.5.3 Income Profile

The incomes of the surveyed households are not limited to agriculture but derived from diverse sources, as shown in Figure 5.2. On average, contract and noncontract farmers have similar incomes from non-rice sources (2.4 million and 2.3 million kip/adult, respectively). However, noncontract farmers derive a significantly higher percentage of non-rice income from off-farm activities (77%) than contract households (67%). The composition of off-farm income is similar for both groups, with wage labor comprising nearly half of off-farm income. For wage income, household members typically travel to Vientiane City for employment opportunities.

Contract farmers on average have higher incomes from the sale of crops and livestock, suggesting that they are more oriented toward commercial

Figure 5.2 Average Sources of Income of Surveyed Households



Source: Authors' survey results.

³ \$1 = 9,478.80 kip at the time of this writing (27 November 2007).

production than their noncontract counterparts. As they are located slightly, although not significantly, closer to the highway and market than noncontract households, contract farmers may have better access to market information and be able to take advantage of market demand for their produce.

5.5.4 Credit

Overall, 16% of the surveyed households had loans from the APB, including 20% of contract farmers and 10% of noncontract farmers. Since Lao Arrowny operates in areas immediately outside of the capital city, the surveyed households have better access to formal credit than most small farms in the Lao PDR. In 2003, less than 3% of rural households in the Lao PDR borrowed from the formal sector (Coleman and Wynne-Williams 2006). As the APB generally lends to farmer groups rather than to individual small farms, these results suggest that the contract arrangement can facilitate improved access to credit.

Among farmers borrowing from the APB, there is no significant difference in the amount of credit received. The average loan size from the APB for contract farmers was 2.24 million kip compared with 1.85 million kip for noncontract farmers. As all loans were financed by the APB, the interest rates and repayment terms were largely the same.

5.5 FARMING CHARACTERISTICS

5.5.1 Commercial Rice Field

Relatively few noncontract households engage in commercial production of rice (29% compared with 89% of contract farms). It is interesting to note that the average commercial plot of noncontract households producing rice for sale is 1.43 ha, significantly larger than the average 1.11 ha of contract farmers (Table 5.2). This may imply that the few commercial farmers not under contract are more specialized in commercial production, while contract farmers are farmers in transition to commercial farming.

The majority of surveyed households plant multiple varieties of rice in their commercial plots. In addition to primarily producing organic Japanese rice for Lao Arrowny, some contract farmers also produce CR203 rice under contract with the Beer Lao Brewery Company. This suggests that once farmers become familiar with contract farming through one firm, they are more likely to enter into contract farming with another firm. Both types of farmers typically also plant small amounts of traditional varieties to sell to traders or in the local market.

Table 5.2 Commercial Production: Revenue, Cost, and Profit

Variables	Contract	Noncontract	p-value*
No. of households	296	72	–
Size of commercial area planted (ha)	1.11	1.43	0.0327
Percentage of planted area harvested	98	99	0.6068
Revenue (1,000 kip/ha)	5,237	3,527	0.0008
Rice price (kip/kg)	1,587	1,344	0.0000
Yield (kg/ha)	3,272	2,603	0.0420
Cash Cost (1,000 kip/ha)	2,251	1,778	0.1102
Cash Cost (kip per kg of rice production)	1,290	936	0.0830
Ratio of hired labor cost in total cash cost (%)	32	45	0.0001
Profit per area of land (1,000 kip/ha)	2,924	1,751	0.0307

ha = hectare, kg = kilogram.

* See footnote in Table 5.1.

Source: Authors' calculations.

5.5.2 Rice Price

Contract farmers received significantly higher prices than noncontract farmers. Under the contract, farmers received an average price of 1,911 kip per kilogram (kg) for organic Japanese rice. For other varieties of rice, there is no significant difference in the prices received by contract and noncontract farmers, as rice sold outside of the contract is sold at market prices. Due to the premium price for Japanese rice, the average rice price for all varieties was 1,587 kip/kg for contract farmers and 1,344 kip/kg for noncontract farmers.

The higher-than-market price offered by Lao Arrowny was ranked by 62% of contract farmers as the most important factor influencing their decision to join the contract.

5.5.3 Yield

In addition to receiving higher prices, farmers under contract also had significantly higher yields than noncontract farmers. Contract farmers' average yield for all varieties of rice is 3,272 kg/ha, compared with 2,603 kg/ha for noncontract farmers. The yield difference between contract and noncontract farmers likely reflects the higher intensity and efficiency of production under contract. As stated previously, farmers under contract have better access to inputs and technology, as the contracting firm provides technical assistance and supplies in-kind credit for high-yield seed and fertilizer.

5.5.4 Costs

On average, farmers under contract have higher cash costs than noncontract farmers, spending 1,290 kip to produce 1 kg of rice compared with 936 kip/kg. Contract farmers also have higher total cash costs per hectare of rice field (2.2 million kip vs. 1.8 million kip); however, this difference is not statistically significant.

5.5.5 Material Costs

Contract farmers have significantly higher (cash) material costs than noncontract farmers, averaging 1,474 thousand kip/ha of rice field compared with 920,000 kip/ha. The difference was also significant for material costs per kilogram of rice production (852 kip/kg vs. 462 kip/kg). For both contract and noncontract farmers, fertilizer is the largest material expense. Contract farmers, however, have significantly higher fertilizer costs, spending on average 814,000 kip/ha, compared with 528,000 kip/ha for noncontract farmers.

Table 5.3 Material Cost Structure for Commercial Operation

Variables	Contract	Noncontract	p-value*
Total material cost (1,000 kip/ha)	1,474	920	0.0044
Total material cost (kip/kg)	852	462	0.0127
Seed cost (1,000 kip/ha)	283	81	0.0009
Seed cost (kip per kg of rice production)	192	41	0.0144
Seed price (kip/kg)	2,842	1,913	0.0000
Fertilizer cost (1,000 kip/ha)	814	528	0.0567
Fertilizer cost (kip per kg of rice production)	429	272	0.1239
Fertilizer price (kip/kg)	3,347	3,231	0.2223
Pesticide cost (1,000 kip/ha)	0.31	0.33	0.9256
Pesticide cost (kip per kg of rice production)	2.78	1.67	0.4733
Irrigation cost (1,000 kip/ha)	180	137	0.2203
Irrigation cost (kip per kg of rice production)	107	74	0.1885
Rental machine cost (1,000 kip/ha)	136	166	0.4686
Rental machine cost (kip per kg of rice production)	82	71	0.6249

ha = hectare, kg = kilogram.

* See footnote in Table 5.1.

Source: Authors' calculations.

Similarly, contract farmers also have significantly higher seed costs than noncontract farmers, both per hectare (283,000 kip/ha vs. 81,000 kip/ha) and per kilo of rice production (192 kip/kg vs. 41 kip/kg).

On average, contract and noncontract farmers do not differ significantly in the use of compost, pesticides, irrigation, or machine rental cost (Table 5.3).

5.5.6 Labor Structure

Commercial production under contract is significantly more labor-intensive than production outside of the contract, requiring an average of 147 days of labor per hectare compared with 88 days per hectare for noncontract farms (Table 5.4). In terms of labor composition, family labor accounts for 80% of contract farms' total labor and 67% of noncontract farms' total labor. The amount and cost of hired labor does not differ significantly between contract and noncontract farmers. On average, the cost of hired labor for contract farms was 783,000 kip/ha, compared with 792,000 kip/ha for noncontract farms. Contract farms used slightly more female hired labor than noncontract farms, although the difference is not significant.

5.5.7 Profitability

Although they have higher costs than noncontract farmers, contract farmers are compensated by higher yields and price premiums. As a result, contract farmers are significantly more profitable than farmers outside the

Table 5.4 Labor Cost Structure for Commercial Operation

Variables	Contract	Noncontract	p-value*
Hired labor (days/ha)	26.0	24.1	0.7985
Hired labor cost (1,000 kip/ha)	783	792	0.9563
Hired labor cost (kip/kg)	431	442	0.9010
Ratio of females in hired labor (%)	59	52	0.1593
Family labor (days/ha)	118.4	58.8	0.0000
Family labor (kg/day)	55.7	60.7	0.5378
Total labor (days/ha)	146.4	87.8	0.0006
Ratio of family labor in total labor (%)	80	67	0.0015
Ratio of hired labor in total labor (%)	20	33	0.0015

ha = hectare, kg = kilogram.

* See footnote in Table 5.1.

Source: Authors' calculations.

contract, earning an average of 2.924 million kip/ha of rice field, compared with 1.751 million kip/ha earned by noncontract farmers.

5.6 PROPENSITY SCORE AND MATCHING ANALYSIS

In an impact assessment study, one of the most difficult issues is the possibility of selection biases. This problem occurs because we would like to know the effect of a treatment on the participants' outcome but cannot observe the outcomes with and without treatment on the same individual at the same time. Simply comparing mean outcomes may not reveal the actual treatment effect, as participants and non-participants typically differ even in the absence of treatment (Caliendo and Kopeinig 2005). For example, contract farmers may differ systematically from noncontract farmers and the above simple mean comparisons may reflect differences in their characteristics rather than the impacts of contract farming. In other words, failure to account for treatment selection biases may lead to biased estimation of the true treatment effect.

The propensity score matching (PSM) method (Becker and Ichino 2002) provides a more refined method of comparing the performance of contract and noncontract farmers by accounting for their inherent differences. The basic concept is to compare contract farmers to noncontract farmers who are similar to contract farmers in all relevant characteristics except the contract. The differences in the outcomes of contract farmers and the selected noncontract farmers can then be attributed to the contract.

The first step of the PSM approach is to estimate farmers' propensity scores based on their basic characteristics (i.e., characteristics that are not affected by the choice of contract). The propensity score of each farmer measures his or her tendency to join the contract. The magnitude of a propensity score ranges between 0 and 1; the larger the score, the more likely the farmer is to join the contract.

After farmers' propensity scores are estimated, the second step is to divide farmers into groups of similar propensity scores. In addition, each group should be balanced, containing farmers who do not have significantly different characteristics.

After the balanced groups are formed, we can compare the performance of contract and noncontract farmers in each group. As such comparisons are based on stratification control for the differences of farmers' characteristics, the performance differences between contract and noncontract farmers

would be more likely caused by contract farming rather than farmers' intrinsic characteristics.

Finally, the performance difference between contract and noncontract farmers can be measured by the weighted average of the contract and noncontract differences in each group, with the number of observations in each group as the weights.

The propensity score approach is used here to compare contract farmers' and noncontract farmers' performance in their commercial operation. The following variables are used in the propensity score estimation (i) farm size, (ii) number of adult family members, (iii) ratio of females in the family, (iv) value of production assets, (v) value of consumption assets, (vi) value of transportation assets, (vii) farm distance to highway, and (viii) farm distance to market (see Chapter 3, this book for the formulation of the mathematical model).

Table 5.5 presents the differences in the performance of contract and noncontract farms, using simple mean and propensity score matching comparisons. The findings of the PSM comparisons are consistent with the results of the simple mean comparisons. They indicate that contract

Table 5.5 Propensity Score Matching Comparison of Contract and Noncontract Farms

Variables	Difference (Contract minus Noncontract)	
	Simple Mean	PSM Comparison
Revenue (1,000 kip/ha)	1,710	1,949
p-value	0.0008	0.0000
Rice Price (kip/kg)	243	266
p-value	0.0000	0.0000
Yield (kg/ha)	669	794
p-value	0.0420	0.0058
Cash Cost (1,000 kip/ha)	473	564
p-value	0.1102	0.0542
Cash Cost (kip/kg)	354	343
p-value	0.0830	0.0360
Cash Profit (1,000 kip/ha)	1,173	1,296
p-value	0.0307	0.0013

ha = hectare, kg = kilogram, PSM = propensity score matching.

Source: Authors' calculations.

farms have higher revenue, rice price, yield, cash costs, and profit than noncontract farms, and that the results are statistically significant.

The use of PSM to minimize selectivity bias thus suggests that these differences are the result of contract farming rather than the intrinsic characteristics of the sampled households. However, like the simple mean comparison, PSM may misinterpret the treatment effect, because it only controls for observed variables, and hidden self-selectivity bias may remain. As the decision to join the contract is voluntary and is based on individual self-selection, it is possible that contract farmers have systematically different *unobserved* characteristics from noncontract farmers. For example, farmers' motivation may be an unobserved covariate affecting both their performance and their decision to join the contract. To address these unobservable selection biases, we employ an endogenous switching regression model (see Chapter 3, this book for the mathematical model).

5.6.1 Comparison of Profitability in Commercial Rice Farming

Based on the above switching regression model, we use the “movestay” module (Lokshin and Sajaia 2004) in the STATA program to evaluate factors that affect farmers' decisions to join the contract and their performance with or without the contract. We measure farmers' performance by their profits per hectare in their commercial operations.

The selection model includes the following variables (i) household characteristics, including family size and ratio of females in the household; and (ii) farm characteristics, including farm size, value of production assets, value of consumption assets, value of transportation assets, distance of farm to market, and distance of farm to highway. The profit functions⁴ include land (farm size), labor (family size) and capital (value of production assets) and their interactions. The estimated results of the selection model and profit functions are presented in Tables A5.1 and A5.2 in the appendix, respectively. The overall model is significant at the 10% level as indicated by Wald's χ^2 .

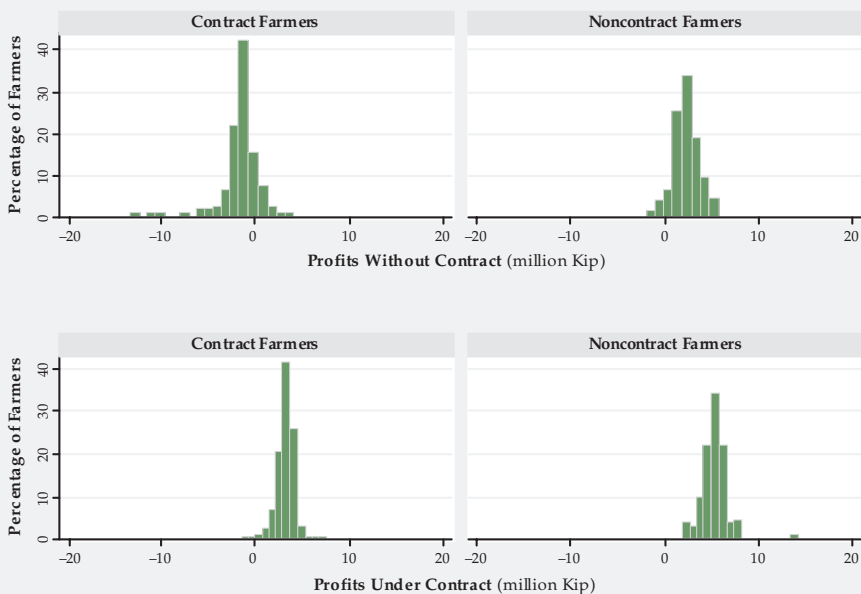
Using the indicators described above, the premiums from joining the contract and their selection bias indicators are calculated. Figure 5.3 depicts the distribution of contract and noncontract farmers' profits under contract and without the contract.

⁴ Due to the unavailability of data to formulate a traditional profit function, we resort to a more “ad hoc” specification in this case.

The counterfactual analysis indicates that both contract and noncontract farmers tend to increase their profitability by joining the contract. The contract farmers' profits under contract (bottom left graph) are on average higher than their counterfactual profits without the contract (top left graph). Joining the contract is estimated to have increased the profits of contract farmers by 4.63 million kip. In the case of noncontract farmers, the counterfactual profits under contract (bottom right graph) are on average higher than the actual profits outside the contract (top right graph). In other words, the profits of noncontract farmers would have increased by 3.21 million kip had they joined the contract.

As shown in Table A1 in the appendix, the estimated ρ_0 and ρ_1 are both negative, although ρ_1 is not statistically significant. This pattern is described as case 3 (see Chapter 3, section 3.4 to this book), indicating that contract farmers have below-average performance both under contract and without the contract. In other words, contract farmers are less profitable than noncontract farmers, both under contract and without the contract. This

Figure 5.3 Profitability Comparison of Contract and Noncontract Farmers



Source: Graphs by contract 1. Stata results performed by the authors.

suggests that the observed higher profitability of contract farming is not due to contract farming attracting more profitable farms; rather, contract farming tends to be more attractive and more beneficial to farmers with relatively low performance.

5.7 CONCLUSION

The rapid expansion of contract farming in the Lao PDR necessitates the empirical verification of its impacts on farmers. As we cannot compare the same farmer both under contract and outside the contract, we must estimate the average impact of contract farming by comparing groups of contract and noncontract farmers. As contract farmers may be different, however, from noncontract farmers in many ways and the decision to join the contract is voluntary, these unobservable factors may lead to selection and self-selection biases. Controlling for these biases is generally the most difficult part of an impact assessment study.

To account for the possible occurrence of selection bias and disentangle the effects of contract farming, this study employed propensity score matching comparison methodology. The findings of the PSM comparison confirm the results of the initial assessment and verify that the higher revenue and profitability of contract farms are the result of joining contract farming, rather than systematic differences between contract and noncontract farms.

To control for potential hidden self-selection biases affecting their decisions to join the contract, farmers' performance with and without the contract was evaluated using an endogenous switching regression model. The results of the switching regression provide evidence that contract farming tends to be more profitable than noncontract farming, and suggests that the higher profitability of contract farms is not the result of farms with higher profit potential joining the contract. In fact, the counterfactual simulations indicate that contract farmers would have lower profits than noncontract farms if they operated outside of the contract. In other words, contract farming is particularly attractive to farmers with relatively poor performance. This finding has strong development implications as it implies that better-off farmers may have better access to information on production and markets and therefore choose to produce independently rather than taking on the burden of fulfilling the requirements of a contract. In this context, the contract farming arrangement is an attractive development tool as it effectively targets relatively poor-performing farmers, who require the most support.

The results of the empirical analysis support the claim that contract farming is an effective tool to increase the incomes of smallholder farmers in rural areas where market failure is prevalent. The findings show that the sampled contract rice farmers cultivated higher-yielding, improved rice varieties and earned higher incomes than noncontract rice farmers under similar agroecosystem and socioeconomic conditions. The sampled contract farmers have better access to inputs and credit and an assured market for their produce, which enables them to earn higher profits. The evidence also suggests that contract farmers are more likely to diversify production into other commercial crops or livestock, leading to increased incomes and more secure livelihoods. The contract arrangement thus appears to be effective in facilitating the transition of small farmers from subsistence to commercial production.

The role of extending new technology to improve the productivity of the agriculture sector is traditionally performed by the public sector. Moving the vast number of subsistence farmers toward commercial production, however, requires enormous public sector resources that are generally unavailable in transition economies such as the Lao PDR. This study shows that promoting contract farming arrangements to draw FDI into the rural sector has been a policy in the right direction.

Through contract farming, the private sector effectively extends new production technology and facilitates access to modern inputs and remote markets offering higher prices. This translates into improved incomes and an effective transformation from subsistence to commercial production with no financial burden to the public sector. Contract farming appears to be particularly appropriate for rural areas where transport infrastructure has recently been established and in transition economies where institutions to facilitate market exchange are in an early stage of development.

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Appendix

Table A1 Endogenous Switching Regression Estimation Results
(Lao PDR Conventional Rice Farming)

Selection Model	Coefficient	Std. Err.	z	P > z
Land (farm size)	-0.7840	0.3993	-1.9600	0.0500
Labor (family size)	0.2806	0.3543	0.7900	0.4280
Capital (production assets)	0.0189	0.0389	0.4900	0.6270
Capital × Labor	-0.0260	0.0266	-0.9800	0.3290
Capital × Land	-0.0125	0.0160	-0.7800	0.4350
Land × Labor	0.5750	0.2832	2.0300	0.0420
Ratio of females in household	-0.7022	0.5208	-1.3500	0.1780
Transportation assets	0.0056	0.0181	0.3100	0.7560
Consumption assets	0.0208	0.0198	1.0500	0.2930
Distance to highway	0.1529	0.1166	1.3100	0.1890
Distance to market	0.2175	0.0761	2.8600	0.0040
Constant	0.0350	0.6253	0.0600	0.9550
σ_0	0.0153	0.0027		
σ_1	0.0307	0.0015		
ρ_0	-0.7218	0.1504		
ρ_1	-0.2038	0.2069		

Number of observations: 295 (241 contract conventional farmers; 54 noncontract conventional farmers)

Wald $\chi^2(10) = 10.73$

Prob > $\chi^2 = 0.0971$

Log likelihood = 531.89

Source: Authors' calculations.

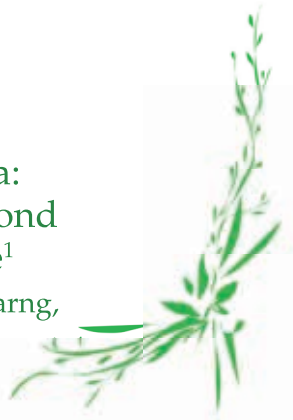
Table A2 Profit Functions

Profit Functions	Coefficient	Std. Err.	z	P > z
Profit without contract				
Land (farm size)	0.0154	0.0114	1.3500	0.1780
Labor (family size)	-0.0024	0.0081	-0.3000	0.7640
Capital (production assets)	-0.0006	0.0010	-0.6700	0.5040
Capital × Labor	0.0008	0.0007	1.1400	0.2550
Capital × Land	-0.0007	0.0004	-1.8200	0.0680
Land × Labor	-0.0092	0.0078	-1.1800	0.2380
Constant	18.9919	0.0128	1,485.7300	0.0000
Profit under contract				
Land (farm size)	-0.0131	0.0083	-1.5700	0.1150
Labor (family size)	0.0014	0.0071	0.1900	0.8480
Capital (production assets)	0.0002	0.0007	0.2700	0.7860
Capital × Labor	0.0001	0.0005	0.1200	0.9030
Capital × Land	0.0000	0.0003	0.0800	0.9390
Land × Labor	0.0065	0.0058	1.1100	0.2670
Constant	19.0099	0.0102	1,859.1200	0.0000

Source: Authors' calculations.

6. Rice Contract Farming in Cambodia: Empowering Farmers to Move Beyond the Contract Toward Independence¹

Junning Cai, Luyna Ung, Sununtar Setboonsarng, and PingSun Leung



6.1 INTRODUCTION

Agriculture is the backbone of the economy in Cambodia where 80% of the population lives in rural areas. Despite the accelerated expansion in other sectors such as industry and services since 1993, agriculture still offers a promising opportunity for growth given the country's flat fertile agricultural lands and access to rivers and tributaries (Siphana, Sotharith, Vannarith 2011). The development of agriculture can provide opportunities for 30% of the population of 14.31 million that live below the national poverty line (World Bank 2012). The sector employed more than 68% of Cambodia's rural labor force in 2007 and accounted for more than 30% of the country's gross domestic product from 2004–2007 with an average growth rate of 9% (EIC 2008).

Rice farming is the major agricultural activity in Cambodia, accounting for nearly one-third of the country's total agricultural value added. The country became self-sufficient in rice since 2000, producing rice on roughly 2.3 million hectares of land (Mund 2010). However, due to inefficient farming techniques and limited irrigation networks, the yield level of rice farming in Cambodia is well below that of its neighbors. The national average yield of rice in Cambodia is estimated at 1.65 and 1.8 tons per hectare (t/ha) in the wet season and 2.05 t/ha in total. This level is less than half of those in Viet Nam (4.8 t/ha) and Lao People's Democratic Republic ([Lao PDR] at 3.29 t/ha) in 2007 (IRRI 2005 cited in Mund 2010). Based on 2010 FAOStat data, although the country exported rice (51,181 tons at \$682 per ton), its total rice import volume (67,243 tons at \$817 per ton) and unit value per ton were higher than exports figures in that year. Given the current relatively low yields and quality, and the large remaining uncultivated area, there is significant scope for rice farming development in Cambodia.

Rice farming is particularly suited to Cambodia's natural resource endowments and weather conditions, but its comparative advantage in

¹ First published as Cai, J., L. Ung, S. Setboonsarng and P.S. Leung, 2008. "Rice Contract Farming in Cambodia: Empowered to Move Beyond Contract Farming." ADBI Discussion Paper 109. Tokyo: Asian Development Bank Institute. Available: <http://www.adbi.org/files/dp109.rice.contract.farming.cambodia.pdf>

rice farming is still to be fully developed. The country's rice production is mainly for self-sufficiency, and commercial rice exports are still at an early stage. Limited market access and underdeveloped agricultural infrastructure are two major bottlenecks constraining rice farming development in Cambodia. Given limited government resources for extension services and public investments, contract farming as a privately-led institutional arrangement may help overcome some of the constraints.

For smallholder farmers in transition economies, market access is particularly important as it allows them to sell their produce, and not merely be consumed by their household. These marginal farmers with less contaminated land can earn more if they export to developed markets where consumers with higher income levels are willing to pay premiums for organic products. This makes their clean soil a comparative advantage in organic export market which can attract agrifirms involved in contract farming.

This chapter aims to evaluate the impacts of contract farming on farmers' performance. Using data from an ADBI survey in Cambodia in 2005–2006, the results will identify factors that affect Cambodian rice farmers' decisions to join the contract, and assess their performance with and without the contract. It will also compare contract and noncontract rice farmers in terms of their farming practices, economic conditions, and social characteristics.

6.2 CONTRACT RICE FARMING IN CAMBODIA

Rice contract farming in Cambodia has been implemented by Angkor Kasekam Roongroeung (AKR), a private Cambodian firm established in 1999. It mainly exports noncertified organic Neang Malis (an aromatic Cambodian rice variety introduced by AKR) to the international market.² AKR has invested about \$8 million in a high-tech rice mill that has a processing capacity of up to 10 tons per hour or up to 30,000 tons per year. In 2005, the company worked with farmers in four provinces (Kandal, Kampong Speu, Takeo, and Kampot), which were selected based on their ideal agronomic conditions for the cultivation of the Neang Malis organic rice. The company has been introducing large-scale contract farming arrangements of noncertified organic rice since 2001 and the accumulative

² Neang Malis, a variety similar to the Thai aromatic rice Hom Mali, is relatively nonresponsive to chemical fertilizers, so it is appropriate for organic production. However, due to the high cost of certification, AKR opted to encourage farmers to produce noncertified organic rice, a product of which still commands a high price in the international market.

number of farmers who have joined the contract is reportedly over 32,000 households.

At the start of the contract farming operation, only about 100 farmers joined the contract because of a lack of trust in AKR's contract arrangement, as well as the company's low milling capacity. Subsequently, the total number of contracted households reached 27,346 in 2003 and 32,005 in 2004. More than 80% of the contract farmers are located in a province (Kampong Speu) near the AKR headquarters where the condition of the agriculture infrastructure is generally good.

AKR's experience shows that contract farming was generally successful in Kampong Speu Province and in some nearby areas in Takeo Province. Field observations indicate that the distance from the operating sites to the AKR headquarters is not a factor determining the success of contract farming. Rather, most of the successful cases were farmers in former forestland and land close to mountains where rice can be produced at higher quality and yield. On the other hand, farmers that are close to AKR (and therefore close to main roads) and have more market experience tend to have higher levels of defaulting on the contracts. This latter group of farmers is made up of the former-contract farmers of the survey.

AKR is involved in every stage of rice production and marketing. Its roles include (i) identifying areas suitable for growing fragrant paddy; (ii) establishing farmer associations based on existing commune structures and bringing these under its management; (iii) using these associations to recruit farmers; (iv) delivering improved seeds and technical advice to contract farmers; (v) monitoring and solving production problems; (vi) collecting and purchasing rice output at AKR's gate; (vii) sorting milled and packaged paddy into different types; and (viii) exporting rice to international markets, including Australia; Europe; and Hong Kong, China. Since all steps of production and processing are well coordinated, AKR shortens the supply chain under contract farming and thus lowers transaction costs for rice export, relative to the normal supply chain.

According to AKR's contract arrangement, the company distributes Neang Malis seeds in credit during July and buys back the output from October to January of the following year. This arrangement requires farmers to repay the credit seeds and transport the harvested paddy to the company's rice mills. The amount of seeds that farmers need to return, the minimum guaranteed price, and the penalties for contract defaults are explicitly stated in the contracts. However, while contract farmers agree to obey AKR's

quality control mechanisms, conditions related to production methods are not clearly specified in the contracts. The contracts also do not clearly state AKR's liabilities if it does not buy contracted rice at the predetermined prices. The contracts state that AKR is obligated to buy rice from farmers at the minimum price without clearly specifying the terms of purchase in detail. In practice, AKR often uses technical reasons to reject or lower the prices of rice that farmers have transported to the firm.

AKR establishes commune associations to help enforce contracts. Each commune association consists of a head, a deputy and the village head. The head and deputy are trained by the firm to understand the basic technical aspects of organic farming and the farming of Neang Malis. Each association routinely observes the progress of its members and reports to the AKR management. The progress report includes every stage of production from plowing, transplanting, water management, and harvesting. Each association also provides basic technical advice to its members, advises them not to use chemical fertilizer, and helps them grow other crops after the harvesting season. The associations also help members develop mixed or integrated agriculture (e.g., growing vegetables and raising livestock) to increase incomes and reduce poverty. Commune associations report to AKR any issues related to the production process such as drought, flood, disease, insects, and other significant issues that affect production.

AKR associations appear to be a good model for community-based agricultural development. They provide the basis and experiences for the future development of farmers' associations in Cambodia where farmers are predominantly smallholders. At present, these associations are tightly controlled by the firm and have little bargaining power. The firm channels its policies through the associations and provides extension services via its agents. However, they have a promising future and could develop into independent organizations representing the interests of the community.

6.3 HOUSEHOLD CHARACTERISTICS

The survey was conducted in 2005 in 615 households, consisting of 178 contract farmers, 220 former-contract farmers, and 217 never-contract farmers. Table 6.1 presents the sample farmers' basic characteristics and discussed in this section.

Family size and farm size. On average, contract farmers have larger families and more land. The average family size for contract farmers is 6.19 persons (4.21 adults) per household, greater than former-contract

Table 6.1 Farmers' Characteristics

Variables	Contract^a	Former Contract^a	Never Contract^a
No. of family members	6.19 ^a	5.56 ^b	5.41 ^b
No. of family members older than 14	4.21 ^a	3.93 ^a	3.56 ^b
Percentage of females in family (%)	52 ^a	51 ^a	54 ^a
Total land (ha)	1.71 ^a	1.30 ^b	1.03 ^c
Own land (ha)	1.68 ^a	1.27 ^b	1.00 ^c
Rented land (ha)	0.021 ^a	0.011 ^a	0.006 ^a
Percentage of own land (%)	98.5 ^a	96.9 ^a	97.9 ^a
Percentage of land for rice (%)	96.7 ^b	98.1 ^{a,b}	99.4 ^a
Age of household head	45.25 ^b	47.64 ^a	44.62 ^c
Education of household head (years)	2.83 ^a	2.70 ^a	2.41 ^b
Gender of household head (male = 1, female = 0)	0.86 ^a	0.83 ^a	0.73 ^b
No. of TVs	0.74 ^a	0.78 ^a	0.61 ^b
No. of tractors	0.028 ^a	0.009 ^a	0.023 ^a
No. of plows	0.96 ^a	0.93 ^a	0.80 ^b
No. of threshes	0.006 ^a	0.009 ^a	0.004 ^a
No. of pumps	0.17 ^a	0.16 ^a	0.08 ^b
No. of bikes	1.21 ^a	1.10 ^{a,b}	0.99 ^b
No. of motorbikes	0.50 ^a	0.56 ^a	0.37 ^b
Value of livestock (millions of riel)	3.51 ^a	3.36 ^a	2.51 ^b
Monthly consumption expenditure per person (1,000 riel)	27 ^a	23 ^b	23 ^b
Percentage of homegrown in consumption expenditure	23 ^a	22 ^a	22 ^a
Credit total (1,000 riel)	274 ^a	348 ^a	289 ^a
Percentage of credit from moneylenders (%)	3.7 ^b	3.7 ^b	11 ^a
Percentage of credit from MFI (%)	27 ^b	44 ^a	37 ^{ab}
Percentage of seed credit (%)	44 ^a	11 ^b	1.4 ^c
Percentage of fertilizer credit (%)	7.8 ^b	13 ^a	12 ^a
Percentage of credit from family (%)	17 ^c	26 ^b	36 ^a
Income per adult from non-rice sources (1,000 riel)	333 ^b	566 ^a	553 ^a
Income per adult from other crops (1,000 riel)	52 ^a	36 ^{a,b}	27 ^b

continued on next page

Table 6.1 *continued*

Variables	Contract ^a	Former Contract ^a	Never Contract ^a
Income per adult from off-farm activities (1,000 riel)	280 ^b	530 ^a	526 ^a
Ratio of off-farm income in non-rice income (%)	76 ^b	80 ^b	88 ^a
Ratio of handcraft in off-farm income (%)	9 ^a	9 ^a	13 ^a
Ratio of wage in off-farm income (%)	30 ^a	19 ^b	33 ^a
Ratio of remittance in off-farm income (%)	22 ^a	24 ^a	19 ^a
Ratio of other activities in off-farm income (%)	39 ^b	48 ^a	34 ^b
Distance to farm-to-market road (km)	6.35 ^a	5.28 ^b	6.28 ^a
Distance to highway (km)	10.37 ^a	9.95 ^a	9.99 ^a

ha = hectare, km = kilometer, MFI = microfinance institution.

Note: The three columns represent the average value of each group for the variables. The superscript letters (a, b, or c) following each number indicate the significance of the differences across the three groups under pair-wise mean comparisons. The significance level is 10%. For each variable under comparison, numbers with the same superscript letter are not significantly different; numbers with ^a are significantly greater than numbers with letter ^b or ^c; numbers with ^b are significantly greater than numbers with ^c.

Source: ADBI survey results 2005–2006.

farmers' 5.56 persons (3.93 adults) and never-contract farmers' 5.41 persons (3.56 adults). On average, a contract farming household controls 1.71 hectares of land (1.68 hectares of own land), greater than former-contract farmers' 1.30 hectares (1.27 hectares of own land) and never-contract farmers' 1.03 hectares (1.00 hectare of own land).

The relatively large family and land size may reflect the scale requirements for contract farming. As farmers usually need to split their land for commercial and self-consumption operations due to "taste" preferences in the traditional rice varieties, farmers with small areas of land tend to have insufficient land for planting AKR varieties. As a result of myriad pilot studies, AKR requires at least a hectare of land to be eligible to join contracts to gain production efficiency. Exceptions are farmers with good reputations who join their land together to meet the minimum requirement of 1 hectare per single contract. The minimal land size requirement is also based on experience that small farmers are more likely to break the contract as the costs of breaching it tend to be relatively low for them. Moreover, dealing with farmers with larger lands can help AKR reduce transaction costs. Because larger areas of land require more labor, a larger family size tends to be an advantage for contract farming.

Characteristics of household heads. On average, contract and former-contract farmers' household heads are older, more educated, and less likely to be female. Farmers who are older, more educated, and male tend to have large areas of land. Moreover, they usually have better access to firsthand information and hence are in a better position to make decisions. Farmers in other groups usually follow the decisions of farmers in successful groups. Social connections and interactions are key factors affecting farmers' contract choices.

Household economic conditions. On average, never-contract farmers exist in relatively poor economic conditions. They own less land, and fewer TVs, plows, pumps, bikes, motorbikes, and livestock than contract or former-contract farmers. They also have lower monthly expenditure per household adult member. Poor economic conditions may be a factor hindering farmers from joining the contract because they tend to produce rice for subsistence. In addition, poor economic conditions usually coincide with smaller land areas. Also, poor people are less reliable when it comes to honoring the contract because the costs of breaching the contract are relatively low for them.

Credit composition and sources. Total credits for the three types of farmers do not differ significantly but not for the sources and composition of their credits. As contract farmers are required to plant seeds provided by AKR, the average ratio of seed credit to their total credit (44%) is much higher than for the other two. According to the surveyed farmers, seed credit is one of the major factors affecting farmers' decisions to join the contract, especially as the interest rates on seed credit are relatively much higher. Former-contract farmers have 11% of their total credits from seed credits, while it is only 1.4% for never-contract farmers. As AKR is not a seed company, it only makes the seed available for farmers under the contract. Former-contract farmers usually keep seeds for their own use. When they face a seed shortage, they may either borrow seeds from each other or from farmers under the contract.

Both former-contract farmers and never-contract farmers obtained their credits mainly through microfinance institutions (MFI) (44% and 37%, respectively). Never-contract farmers obtained a higher percentage of their credits from moneylenders and family members or relatives. Since AKR discourages farmers from using chemical fertilizer and pesticides, contract farmers appear to receive less credit (in percentage terms) on fertilizers than former- and never-contract farmers.

Income sources and composition. On average, contract farmers have less income from non-rice sources (333,000 riel) than former-contract farmers (566,000 riel) and never-contract farmers (553,000 riel). This mainly reflects contract farmers' relatively lower off-farm incomes compared with the other two types of farmers. Contract farmers on average have more income from other crops than never-contract farmers because AKR provides extension services on the integrated farming system and encourages farmers to grow other crops after the harvesting season. These income patterns indicate that contract farmers are more rice- (or agriculture-) oriented than former-contract and never-contract farmers.

All three types have similar compositions of off-farm incomes, except that former-contract farmers have a relatively small percentage of off-farm incomes from wages, but more from other activities. Most of the former-contract farmers live close to the market and they tend to engage in trading activities rather than wage employment. It is common for them to be merchants, traders, micro-rice millers, and government officials.

Geographical location. On average, former-contract farmers are closer to the market than contract farmers, which may have affected their decisions not to continue staying in the contract. After a few years of AKR's operation, Neang Mali seeds became available in the local market in the four provinces where AKR is operating. Moreover, a market for Neang Mali rice also emerged as local traders purchased it to sell in Viet Nam. Farmers have the option of using their own seeds or purchasing Neang Mali seeds to produce AKR varieties to sell to traders instead of joining the contract. Farmers weigh the costs and benefits based on their circumstances. Farmers closer to the market may obtain more information and hence their decisions tend to be different. In the case in question, former-contract farmers may have realized that they are better off not joining the contract.

During the survey year, the demand for rice was very strong as neighboring Vietnamese traders came to purchase rice in Cambodia making the rice price in the open market very competitive. Thus, the minimum price offered by AKR was not very attractive, and farmers expected to earn more from operating with their own seeds and using more fertilizer to increase the yield to sell in the open market. As the supply after harvesting is fixed, rice prices depend on demand and storage capacities and facilities, and hence tended to fluctuate highly after the harvest season. People close to the market have better access to market information and hence are able to sell their outputs at better times.

6.4. FARMING CHARACTERISTICS

The sample farmers plant rice for both commercial purposes and self-consumption. Due to taste preference, farmers generally plant traditional varieties on the consumption plots. This section compares three types of farmers' production characteristics in their commercial operations, and presents the farmers' entire operations, including farming for own consumption (Table 6.2).

Table 6.2 Farm Production: Revenue, Cost, and Profit

Variables	Contract ^a	Former Contract ^a	Never Contract ^a
Commercial operation			
Plant area (ha)	0.76 ^a	0.37 ^b	0.08 ^c
Percentage of plant area harvested (%)	46 ^b	59 ^a	70 ^a
Revenue (1,000 riel/ha)	722 ^b	920 ^a	684 ^{ab}
Rice price (riel/kg)	747 ^a	684 ^b	645 ^b
Yield (kg/ha)	947 ^b	1,343 ^a	1,059 ^{a,b}
Cost (1000 riel/ha)	1,493 ^a	1,803 ^a	1,661 ^a
Cost (riel per kg of rice production)	3,238 ^a	3,023 ^a	2,823 ^a
Ratio of cash in cost (%)	34 ^b	38 ^b	46 ^a
Ratio of labor cost in total cost (%)	79 ^a	78 ^a	71 ^b
Profit per area of land (1,000 riel/ha) ²	-771 ^a	-882 ^a	-977 ^a
Cash profit per area of land (1,000 riel/ha) ²	213 ^a	332 ^a	-30 ^a
Entire operation			
Total plant area	1.64 ^a	1.26 ^b	1.02 ^c
Percentage of land for commercial rice	46 ^a	27 ^b	5.4 ^c
Percentage of plant area harvested (%)	46 ^b	55 ^a	50 ^{ab}
Revenue (1,000 riel/ha)	600 ^b	720 ^a	610 ^{ab}
Rice price (riel/kg)	632 ^a	604 ^b	570 ^c
Yield (kg/ha)	920 ^b	1210 ^a	1121 ^{ab}
Cost (1,000 riel/ha)	1,355 ^{a,b}	1,616 ^a	1,291 ^b
Cost (riel per kg of rice production)	4,175 ^a	2,555 ^b	2,394 ^b
Ratio of cash in cost (%)	37 ^b	41 ^a	42 ^a
Ratio of labor cost in total cost (%)	77 ^a	75 ^{a,b}	74 ^b
Profit per area of land (1,000 riel/ha) ²	-755 ^a	-896 ^a	-681 ^a
Cash profit per area of land (1,000 riel/ha) ²	129 ^a	135 ^a	79 ^a

ha = hectare, kg = kilogram, MFI = microfinance institution.

Notes:

¹ See note in Table 6.1.

² Profit is equal to revenue minus total cost including both cash and non-cash costs. Major non-cash costs include family labor and homemade manure. Cash profit is equal to revenue minus cash costs only.

Source: Authors' calculations.

Hectarage of rice fields. On average, contract farmers have larger rice fields and use a higher percentage of their rice fields for commercial purposes (Table 6.2). An average contract farmer controls 1.71 hectares of land (including both own and rented land) and uses 1.64 hectares for rice farming, 46% of which is used to plant commercial rice. An average former-contract farmer controls 1.30 hectares of land and uses 1.26 hectares for rice farming, 26% of which is used to plant commercial rice. An average never-contract farmer controls 1.03 hectares of land and uses 1.02 hectares for rice farming, 5.4% of which is used to plant commercial rice (Table 6.2). The low percentage of commercial rice fields for never-contract farmers indicates that most of them are subsistence farmers. On average, contract farmers have a lower harvest ratio (46%) than former-contract farmers (55%) for the entire operation. The difference is even greater in commercial fields (Table 6.2).

Rice price (riel per kilogram of rice). High rice price is a major factor attracting farmers to join the contract, which not only subjects them to strict quality standards but also constrains their freedom in farming practices, such as the use of seeds and chemicals. Contract farmers enjoy significant price premiums in their commercial operations compared to the other two. On average, contract farmers can sell their commercial rice at 747 riel per kilogram, higher than former-contract farmers' 684 riel per kilogram and never-contract farmers' 645 riel per kilogram (Table 6.2), with the latter two not significantly different from each other.

Revenue (riels per hectare). As contract farmers can sell their rice at higher prices, one may expect that they would have higher revenues, but this turns out not to be the case. On average, contract farmers' revenue (per hectare) from commercial operations is 722,000 riel, which is lower than former-contract farmers' 920,000 riel but not significantly different from never-contract farmers' 684,000 riel.

Yield (kilograms of rice per hectare of land). The reason that contract farmers' price premiums do not give them higher revenues is because of their relatively low yields. Contract farmers' average yield in the commercial field is 947 kilograms per hectare, which is lower than former-contract farmers' 1,343 kilograms but not significantly different from never-contract farmers' 1,059 kilograms (Table 6.2). This may indicate that the organic practice recommended by AKR for contract farmers did not lead to lowering yield from traditional practice. The yield differences between contract and former-contract farmers indicate that inflexibility in farming practices may be a factor motivating farmers to abandon the contract if

there was a ready market for their rice, allowing farmers to farm more intensively to compensate for the lost price premiums.

Cost (riels per hectare or riels per kilogram of rice production). On average, contract farmers spend 1.493 million riel on 1 hectare of commercial rice operation, which appears lower than former-contract farmers' 1.803 million riel and never-contract farmers' 1.661 million riel. However, the differences are not statistically significant. For commercial operations, the average ratio of contract farmers' cash costs to their total costs is 34%, which is not significantly different from former-contract farmers' 38%, but lower than never-contract farmers' 46%. For commercial operations, the average ratio of contract farmers' labor costs to their total costs is 79%, which is not significantly different from former-contract farmers' 78% but higher than never-contract farmers' 71% (Table 6.2).

Profitability (riels per hectare). The average profit (cash and non-cash inputs included) for contract farmers in commercial operations is -711,000 riel per hectare, which appears higher than former-contract farmers' -882,000 riel and never-contract farmers' -977,000 riel. However, the differences are not statistically significant. While contract farmers' average total profit is negative, their average cash profit is 213,000 riel per hectare, which reflects the fact that most of their costs (66%) are non-cash costs (mainly family labor). Former-contract farmers' 332,000 riel of cash profit appears higher than that of contract farmers, but the difference is not statistically significant. There are only 27 never-contract farmers reporting activities in commercial rice farming; and their average cash profit is only -30,000 riel (Table 6.2).

Labor structure. On average, contract farmers spend 1,250,000 riel on labor costs (266,000 riel in cash) on 1 hectare of commercial operation, lower than former-contract farmers' 1,522,000 riel (308,000 riel in cash) and never-contract farmers' 1,308,000 riel (361,000 riel in cash), but the differences are not statistically significant. On average, contract farmers spend 2,695 riel on labor costs to produce 1 kilogram of rice in their commercial operations, higher than former-contract farmers' 2,237 riel and never-contract farmers' 2,261 riel, but the differences are not statistically significant. On average, the three types of farmers are not significantly different in their commercial operations with respect to the ratio of family labor in total labor, the ratio of hired labor in total labor, or the ratio of females in total labor. However, contract farmers use a relatively lower percentage of exchanged labor in their commercial operations (Table 6.3).

Table 6.3 Labor Cost

Variables	Contract ^a	Former Contract ^a	Never Contract ^a
Commercial operation			
Labor cost (1,000 riel/ha)	1,250 ^a	1,522 ^a	1,308 ^a
Labor cost (riel per kg of rice production)	2,695 ^a	2,237 ^a	2,261 ^a
Cash labor cost (1,000 riel/ha)	266 ^a	308 ^a	361 ^a
Cash labor cost (riel per kg of rice production)	409 ^a	409 ^a	500 ^a
Ratio of family labor in total labor (%)	86 ^a	86 ^a	83 ^a
Ratio of hired labor in total labor (%)	9.6 ^a	7.9 ^a	11 ^a
Ratio of exchanged labor in total labor (%)	4.3 ^b	6.3 ^a	6 ^{ab}
Ratio of females in total labor (%)	48 ^a	47 ^a	53 ^a
Entire operation			
Labor cost (1,000 riel/ha)	1,106 ^{ab}	1,305 ^a	1,017 ^b
Labor cost (riel/kg)	3,424 ^a	1,847 ^b	1,991 ^b
Cash labor cost (1,000 riel/ha)	222 ^a	274 ^a	257 ^a
Cash labor cost (riel/kg)	143 ^a	144 ^a	180 ^a
Non-cash labor cost (1,000 riel/ha)	884 ^{a,b}	1,031 ^a	760 ^b
Non-cash labor cost (riel/kg)	711 ^a	580 ^a	581 ^a
Ratio of family labor in total labor (%)	85 ^a	82 ^{a,b}	80 ^b
Ratio of hired labor in total labor (%)	7.7 ^b	12 ^a	12 ^a
Ratio of exchanged labor in total labor (%)	10 ^a	9.5 ^a	10 ^a
Ratio of females in total labor (%)	49 ^b	48 ^b	52 ^a

ha = hectare, kg = kilogram.

Note: See note in Table 6.1.

Source: Authors' calculations.

Material and operating costs. On average, contract farmers spend 242,000 riel on material costs (including transportation costs) per hectare of commercial field, lower than former-contract farmers' 280,000 riel and never-contract farmers' 353,000 riel, but the differences are not statistically significant (Table 6.4). On average, contract farmers use 543 riel of material costs to produce 1 kilogram of rice, lower than former-contract farmers' 786 riel and never-contract farmers' 561 riel, but the differences are not statistically significant (Table 6.4).

Seed costs and price. On average, contract farmers spend 52,000 riel on seeds for 1 hectare of commercial operation, which is lower than former-

Table 6.4 Material and Operating Cost Structure

Variables	Contract ^a	Former Contract ^a	Never Contract ^a
Commercial operation			
Material cost (1,000 riel/ha)	242 ^a	280 ^a	353 ^a
Material cost (riel per kg of rice production)	543 ^a	786 ^a	561 ^a
Seed cost (1,000 riel/ha)	52 ^b	74 ^a	53 ^b
Seed cost (riel per kg of rice production)	135 ^a	153 ^a	109 ^a
Seed price (riel/kg)	693 ^a	664 ^a	685 ^a
Chemical fertilizer cost (1,000 riel/ha)	59 ^b	70 ^b	110 ^a
Chemical fertilizer cost (riel per kg of rice production)	180 ^{a,b}	90 ^b	224 ^a
Chemical fertilizer price (riel/kg)	1,153 ^a	1,154 ^a	1,153 ^a
Compost cost (1,000 riel/ha)	66 ^b	64 ^b	103 ^a
Compost cost (riel per kg of rice production)	126 ^a	285 ^a	133 ^a
Compost price (riel/cart)	5,311 ^a	4,460 ^b	6,130 ^a
Pesticide cost (1,000 riel/ha)	1.21 ^a	0.61 ^a	0.68 ^a
Pesticide cost (riel per kg of rice production)	4.04 ^a	0.43 ^b	0.28 ^{a,b}
Irrigation cost (1,000 riel/ha)	16 ^b	34 ^{a,b}	42 ^a
Irrigation cost (riel per kg of rice production)	22 ^a	133 ^a	36 ^a
Rental machine cost (1,000 riel/ha)	50 ^a	42 ^a	44 ^a
Rental machine cost (riel per kg of rice production)	73 ^a	124 ^a	58 ^a
Transportation cost (riel per kg of rice)	44 ^a	8.1 ^{a,b}	5.3 ^b
Entire operation			
Material cost (1,000 riel/ha)	248 ^b	311 ^a	274 ^{a,b}
Material cost (riel/kg)	751 ^a	547 ^a	564 ^a
Seed cost (1,000 riel/ha)	48 ^b	63 ^a	48 ^b
Seed cost (riel per kg of rice production)	42 ^a	42 ^a	40 ^a
Seed price (riel/kg)	622 ^a	615 ^a	598 ^a
Chemical fertilizer cost (1,000 riel/ha)	86 ^b	126 ^a	109 ^{a,b}

continued on next page

Table 6.4 *continued*

Variables	Contract ^a	Former Contract ^a	Never Contract ^a
Chemical fertilizer cost (riel per kg of rice production)	70 ^a	79 ^a	81 ^a
Chemical fertilizer price (riel/kg)	1,237 ^{a,b}	1,167 ^b	1,481 ^a
Compost cost (1,000 riel/ha)	58 ^b	70 ^a	74 ^a
Compost cost (riel per kg of rice production)	36 ^b	56 ^a	62 ^a
Compost price (riel/cart)	5,586 ^a	5,262 ^a	6,724 ^a
Pesticide cost (1,000 riel/ha)	0.75 ^a	0.74 ^a	0.88 ^a
Pesticide cost (riel per kg of rice production)	0.48 ^a	0.79 ^a	0.31 ^a
Irrigation cost (1,000 riel/ha)	15 ^a	24 ^a	13 ^a
Irrigation cost (riel per kg of rice production)	6.6 ^a	10.5 ^a	9.7 ^a
Rental machine cost (1000 riel/ha)	33 ^a	36 ^a	37 ^a
Rental machine cost (riel per kg of rice production)	18 ^a	19 ^a	34 ^a

ha = hectare, kg = kilogram.

Note: See note in Table 6.1.

Source: Authors' calculations.

contract farmers' 74,000 riel but not significantly different from never-contract farmers' 53,000 riel. On average, the three types of farmers do not differ significantly in their seed costs in terms of per kilogram of rice production. Their seed prices are also not significantly different (Table 6.4).

Efficiency and use of chemical fertilizer. With respect to commercial operations, the average chemical fertilizer costs per hectare for contract farmers and former-contract farmers (59,000 riel and 70,000 riel, respectively) are significantly lower than for never-contract farmers' (110,000 riel). On average, former-contract farmers spend 90 riel of chemical fertilizers in producing 1 kilogram of rice, lower than contract farmers' 180 riel and never-contract farmers' 224 riel. There is no significant difference in the prices of chemical fertilizer encountered by the three types of farmer (Table 6.4).

Former-contract farmers may have benefited from AKR's soil improvement techniques resulting in relatively high efficiency in chemical fertilizer use (in terms of cost per kilogram of rice production). In contrast, never-

contract farmers' never received such soil training, hence they may use more chemical fertilizers for the same yield.

While AKR does not recommend the use of chemical fertilizer, its monitoring system is weak and it is unclear about its prescribed organic practices. During field visits, farmers explained that as they used chemical fertilizers only during land preparation and not during the cultivation period, they considered themselves compliant with AKR's requirements.

Compost per hectare. On average, contract farmers use 66,000 riel of compost on 1 hectare of commercial field, which is similar to former-contract farmers' 64,000 riel but lower than never-contract farmers' 103,000 riel. The price of compost is significantly higher for never-contract farmers (6,130 riel per cart) compared to 5,311 riel per cart for contract farmers and 4,460 riel per cart for former-contract farmers (Table 6.4).

As never-contract farmers have a significantly lower number of livestock, they may have to rely on purchased manure. However, it is not clear whether the lower use of compost among contract and former-contract farmers is due to a better quality of land or a lack of available compost, or a result of AKR's awareness-raising efforts on compost use.

Pesticides cost per hectare. All three types of farmers have very low pesticide costs for 1 hectare of commercial operation, which are not statistically different (Table 6.4). It should be noted that the pesticides used by contract farmers could be biological pesticides because AKR extended technologies for making biological pesticides using herbal extract to farmers under contract. Unfortunately, the questionnaire did not distinguish between biological and chemical pesticides.

Irrigation cost per hectare. Contract farmers' average irrigation cost for commercial operations is 16,000 riel per hectare, lower than former-contract farmers' 34,000 riel per hectare (not statistically significant) and never-contract farmers' 42,000 riel (Table 6.4). This indicates that contract farmers may have a better water supply and/or they have better agricultural land.

Machinery cost per hectare. Contract farmers' average machinery cost of 50,000 riel per hectare appears higher than former-contract farmers' 42,000 riel and never-contract farmers' 44,000 riel, but the differences are not statistically significant. Their machinery costs in terms of per kilogram of rice production are also not statistically significant (Table 6.4).

Transportation cost. Contract farmers' average transportation cost (per kilogram of rice production) is 44 riel, higher than former-contract farmers' average 8.1 riel (not statistically significant) and never-contract farmers' average 5.3 riel.

6.5 PROPENSITY SCORE MATCHING ANALYSIS

As the above comparisons do not control for farmers' characteristic differences, the mean differences in farming performance between contract and noncontract farmers may be caused by farmers' characteristics rather than their contract or noncontract states. In the following, we use the propensity score matching (p-score) method (Becker and Ichino 2002) to conduct a more refined comparison by controlling for farmers' characteristic differences.

The first step of the p-score approach is to estimate farmers' propensity scores based on their basic characteristics (i.e., characteristics that are not affected by the choice of contract). The propensity score of each farmer measures his or her tendency to join the contract. The magnitude of a propensity score is between 0 and 1; the larger the score, the more likely the farmer would be to join the contract.

After farmers' propensity scores are estimated, the second step is to divide farmers into groups. Farmers in each group have similar propensity scores. In addition, each group should be balanced in the sense that the basic characteristics of the farmers in it are not significantly different.

After the balanced groups are formed, we can compare different types of farmers in each group. As such comparisons control for farmers' characteristic differences, the performance differences between contract and noncontract farmers are more likely to be caused by contract farming rather than by farmers' basic characteristics.

The above p-score comparison method is usually called "stratification" comparison in that the two groups under comparison are stratified into one-to-one matching subgroups for comparison. Besides the stratification comparison, another comparison method called the "nearest neighbor" comparison is to compare each contract farmer to the noncontract farmer with the most similar p-score (Becker and Ichino 2002).

In this study, we use the stratification comparison as the main approach and the nearest-neighbor comparison as an additional approach to enhance

the robustness of the comparisons. For example, if both comparison approaches indicate that contract farmers have higher profits than never-contract farmers, and the differences are statistically significant, we would have the confidence to conclude that contract farming tends to improve profitability. If both approaches indicate that contract farmers have higher profits, and the difference is statistically significant under one approach but not under the other, the conclusion that contract farming improves profitability would still be sound but less robust than in the first situation. The most troublesome situation would be where one approach indicates that contract farmers have significantly higher profits while the other approach indicates the exact opposite. Fortunately, we do not encounter such situations in this study (see Chapter 3, this book for the description of the model).

We include the following variables in the p-score estimation (i) size of own land; (ii) value of production assets; (iii) value of consumption assets; (iv) age of the household head; (v) gender of the household head; (vi) educational level of the household head; (vii) number of adult family members; (viii) female ratio in the family; (ix) distance from farm to market; (x) distance from farm to highway; (xi) dummy variable identifying province 2; (xii) dummy variable identifying province 3; and (xiii) dummy variable identifying province 4.

We use the p-score approach to conduct three comparisons. One is to compare contract farmers and never-contract farmers' performance in their entire operations (including both commercial and self-consumption operations); another is to compare contract farmers and former-contract farmers' performance in their entire operations; and the last is to compare contract farmers and former-contract farmers' performance in their commercial operations.

6.5.1 Contract Farmers vs. Never-Contract Farmers (Entire Operations)

Table 6.5 shows the results of the p-score comparison of contract farmers and never-contract farmers' performance in their entire operations.

Since contract farmers (as the treatment group) are compared to different never-contract farmers (as the control group) under the stratification approach and the nearest-neighbor approach, the results based on the two approaches may not be consistent. As mentioned, we use the nearest-neighbor comparisons to examine the robustness of the results from the stratification comparisons.

The ideal situation would have been to compare the commercial operations of contract and never-contract farmers. Unfortunately, as never-contract farmers have very limited areas for commercial purposes, there are only 27 never-contract farmers reporting their commercial operations (compared to 170 contract farmers), which makes the p-score comparisons highly imbalanced and uninformative. Therefore, we use the p-score approach to compare contract and never-contract farmers' performance in their entire operations only. It should be noted that since the sizes of consumption fields operated by contract farmers differ widely, the combined impacts may dilute the findings on the impact of commercialization.

Table 6.5 P-score Comparison of Contract and Never-Contract Farmers (Entire Operations)

Variables	Difference (Stratification)	Difference (Nearest Neighbor)
No. of observations (contract vs. never-contract)	178 vs. 197	178 vs. 63
Rice price (riel/kg)	26	17
t-ratio	1.231	0.766
Revenue (1,000 riel/ha)	158	183
t-ratio	2.649	2.978
Yield (kg/ha)	159	194
t-ratio	1.411	1.761
Cost (1,000 riel/ha)	392	302
t-ratio	3.617	1.940
Cost (riel per kg of rice production)	1,777	1,195
t-ratio	1.968	0.972
Cash cost (1,000 riel/ha)	29	37
t-ratio	0.444	0.318
Cash cost (riel per kg of rice production)	417	245
t-ratio	0.933	0.589
Profit (1,000 riel/ha)	-244	-119
t-ratio	1.964	1.501
Cash profit (1,000 riel/ha)	129	146
t-ratio	2.002	1.884

ha = hectare, kg = kilogram.

Source: Authors' calculations.

- Both the stratification and nearest-neighbor comparisons indicate that contract farmers have a higher average rice price than never-contract farmers in their entire operations, but the difference is not statistically significant under either approach.
- Both the stratification and nearest-neighbor comparisons indicate that contract farmers have higher average revenue than never-contract farmers in their entire operations; and the difference is statistically significant under both approaches.
- Both the stratification and nearest-neighbor comparisons indicate that contract farmers have a higher average yield than never-contract farmers in their entire operations; the difference is significant under the nearest-neighbor comparison but not under the stratification comparison.
- Both the stratification and nearest-neighbor comparisons indicate that contract farmers have a higher average cost in terms of per hectare of rice field than never-contract farmers in their entire operations; and the difference is statistically significant under both approaches. Both comparisons indicate that contract farmers also have a higher average cost in terms of per kilogram of rice production than never-contract farmers in their entire operations; and the difference is statistically significant under the stratification approach but not under the nearest-neighbor approach.
- Both the stratification and nearest-neighbor comparisons indicate that compared to never-contract farmers, contract farmers have a higher average cash cost in terms of per hectare or per kilogram of rice production in their entire operations, but the difference is not statistically significant under either approach.
- Both the stratification and nearest-neighbor comparisons indicate that contract farmers have a lower average profit than never-contract farmers in their entire operations. The difference is statistically significant under the stratification approach but not under the nearest-neighbor approach.
- Both the stratification and nearest-neighbor comparisons indicate that contract farmers have a higher average cash profit than never-contract farmers in their entire operations; and the difference is statistically significant under both approaches.

6.5.2. Contract Farmers vs. Former-Contract Farmers (Commercial Operations)

Table 6.6 shows the results of the p-score comparison of contract farmers and former-contract farmers' performance in their commercial operations.

- Both the stratification and nearest-neighbor comparisons indicate that contract farmers have a higher average rice price than former-contract farmers in their commercial operations; and the difference is statistically significant under both approaches.
- Both the stratification and nearest-neighbor comparisons indicate that contract farmers have lower average revenue than former-contract farmers in their commercial operations. The difference is statistically

Table 6.6 P-score Comparison of Contract and Former-Contract Farmers (Commercial Operations)

Variables	Difference (Stratification)	Difference (Nearest Neighbor)
No. of observations (contract vs. former-contract)	178 vs. 191	178 vs. 58
Rice price (riel/kg)	63	64
t-ratio	4.052	3.748
Revenue (1,000 riel/ha)	-377	-976
t-ratio	1.316	2.235
Yield (kg/ha)	-651	-1,487
t-ratio	1.917	2.349
Cost (1,000 riel/ha)	-329	-788
t-ratio	1.021	1.357
Cost (riel per kg of rice production)	932	1,328
t-ratio	1.317	1.836
Cash cost (1,000 riel/ha)	-65	-300
t-ratio	0.557	1.605
Cash cost (riel per kg of rice production)	114	250
t-ratio	0.565	1.032
Profit (1,000 riel/ha)	-48	-188
t-ratio	0.243	0.740
Cash profit (1,000 riel/ha)	-312	-676
t-ratio	1.466	2.205

ha = hectare, kg = kilogram.

Source: Authors' calculations.

significant under the nearest-neighbor approach but not under the stratification approach.

- Both the stratification and nearest-neighbor comparisons indicate that contract farmers have a lower average yield than former-contract farmers in their commercial operations; and the difference is statistically significant under both approaches.
- Both the stratification and nearest-neighbor comparisons indicate that compared to former-contract farmers, contract farmers have a lower average cost (or cash cost) in terms of per hectare of rice field in their commercial operations, but the difference is not statistically significant under either approach. Both comparisons indicate that compared to former-contract farmers, contract farmers have a higher average cost (or cash cost) in terms of per kilogram of rice production in their commercial operations, but the difference is only statistically significant for the average cost under the nearest neighbor approach. The cost comparisons indicate that former-contract farmers tend to farm more intensively (i.e., higher cost per hectare of rice field); and the higher intensity tends to increase their efficiency in input use (i.e., lower cost per kilogram of cost production).
- Both the stratification and nearest-neighbor comparisons indicate that contract farmers have a lower average profit than former-contract farmers in their commercial operations, but the difference is not statistically significant under either approach. Both comparisons indicate that contract farmers also have a lower average cash profit than former-contract farmers in their commercial operations; and the difference is statistically significant under the nearest neighbor approach but not under the stratification approach. According to the profit comparisons, former-contract farmers seem to be the most progressive farmers. Their experience in contract farming with AKR may have helped them become independent commercial farmers who are able to explore their own markets. Without the constraints imposed by contract farming, these farmers are able to adopt more profitable farming practices.

6.5.3 Contract Farmers vs. Former-Contract Farmers (Entire Operations)

Table 6.7 shows the p-score comparisons of contract and former-contract farmers' performance in their entire operations. The results are mostly similar to the comparisons of their commercial operations. One exception is that the stratification comparison shows that contract farmers' profit in their entire operations is significantly higher than former-contract farmers'.

**Table 6.7 P-score Comparison of Contract and Former-Contract Farmers
(Entire Operations)**

Variables	Difference (Stratification)	Difference (Nearest Neighbor)
No. of observations (contract vs. former-contract)	178 vs. 191	178 vs. 85
Rice price (riel/kg)	24	18
t-ratio	2.064	1.120
Revenue (1,000 riel/ha)	-161	-237
t-ratio	1.651	1.909
Yield (kg/ha)	-321	-429
t-ratio	2.266	2.246
Cost (1,000 riel/ha)	-172	-59
t-ratio	0.823	0.260
Cost (riel per kg of rice production)	1,980	1,926
t-ratio	2.579	1.077
Cash cost (1,000 riel/ha)	-84	-122
t-ratio	0.881	0.961
Cash cost (riel per kg of rice production)	699	676
t-ratio	2.179	2.243
Profit (1,000 riel/ha)	11	-178
t-ratio	0.052	0.833
Cash profit (1,000 riel/ha)	-78	-115
t-ratio	1.207	1.205

ha = hectare, kg = kilogram.

Source: Authors' calculations.

6.6 SWITCHING REGRESSION

While the p-score comparisons in the above try to compare the performance of contract and noncontract farmers with similar intrinsic characteristics, they cannot correct hidden bias because p-score comparison only controls for observed variables (to the extent that they are perfectly measured). For example, farmers' motivation may be an unobserved covariate affecting both farmers' performance and their choices about joining the contract.

Selection models can be used to address unobservable selection bias in deciding whether to join the contract or not. In this section, we use an endogenous switching regression model to account for selection biases.

We use the model to examine how farmers' characteristics affect their decisions to join the contract and their performance with or without the contract. We also compare farmers' expected performance under the contract and without the contract (see Appendix 1 for the modified formulation of the mathematical model in Chapter 3, this book).

6.6.1 Comparison of Profitability in Commercial Rice Farming

Based on the above switching regression model, we use the "movestay" module (Lokshin and Sajaia 2004) in the STATA program to evaluate factors that affect farmers' decisions to join the contract and their performance with or without the contract. We measure farmers' performance according to their profits per hectare in their commercial operations.

In the selection model, we include the following variables:

- The rice price and input prices (i.e., seed, wage, chemical fertilizer, compost, irrigation, and machinery) under contract and without contract. For contract (or noncontract) farmers, the prices without contract (or under contract) are unobservable. We estimate such counterfactual prices by using farmers' geographical locations and their land sizes as two regressors.
- Household characteristics including the age, gender, and educational level of the household head, family size, and the ratio of females in the household.
- Farm characteristics, including the size of own land, the value of production assets, the value of consumption assets (e.g., TV), the distance from the farm to the market, the distance from the farm to the highway, the total number of plows and pumps, and the number of motorbikes.
- Three province dummies to identify farmers from four different provinces.

In the profit functions, we include the rice price, the input prices, the size of own land, the value of production assets, and the three province dummies. For the noncontract profit function, we also include a dummy to differentiate former-contract and never-contract farmers.

Table 6.8 shows the estimation results for the selection function, which suggest the following:

- Households with less asset value are more likely to join the contract.
- Households with younger household heads are more likely to join the contract.

Table 6.8 The Selection Function

Selection model	Coefficient	Std. Err.	Z	P>z	Confidence Interval (95%)	
Rice price (contract)	-0.1102	0.4717	-0.2300	0.8150	-1.0347	0.8143
Rice price (no contract)	-0.5235	0.9183	-0.5700	0.5690	-2.3233	1.2762
Seed price (contract)	-0.0992	0.5456	-0.1800	0.8560	-1.1685	0.9701
Seed price (no contract)	0.1211	0.7405	0.1600	0.8700	-1.3303	1.5724
Chemical price (contract)	-0.3862	0.9196	-0.4200	0.6750	-2.1886	1.4162
Chemical price (no contract)	-0.1967	0.9044	-0.2200	0.8280	-1.9693	1.5758
Compost price (contract)	-0.0821	0.2853	-0.2900	0.7730	-0.6413	0.4770
Compost price (no contract)	0.0539	0.2391	0.2300	0.8220	-0.4147	0.5226
Irrigation price (contract)	-0.0127	0.1933	-0.0700	0.9480	-0.3916	0.3662
Irrigation price (no contract)	0.0230	0.2135	0.1100	0.9140	-0.3955	0.4415
Machinery price (contract)	-0.1348	0.1762	-0.7600	0.4440	-0.4802	0.2106
Machinery price (no contract)	-0.2716	0.2047	-1.3300	0.1850	-0.6728	0.1296
Own land	0.1803	0.1636	1.1000	0.2710	-0.1404	0.5010
Fix production asset	-0.0154	0.0217	-0.7100	0.4760	-0.0579	0.0270
Consumption asset	-0.0130	0.0220	-0.5900	0.5540	-0.0560	0.0300
Age	-0.0191	0.0074	-2.5900	0.0100	-0.0336	-0.0047
Gender	0.2374	0.2101	1.1300	0.2590	-0.1745	0.6492
Education	0.0049	0.0571	0.0900	0.9310	-0.1071	0.1169
Family size	0.0847	0.0589	1.4400	0.1500	-0.0307	0.2002
Female ratio in household	0.2162	0.4423	0.4900	0.6250	-0.6508	1.0832
Distance to market	0.3687	0.1380	2.6700	0.0080	0.0982	0.6392
Distance to highway	-0.3249	0.0832	-3.9000	0.0000	-0.4880	-0.1617
Province 2 (dummy)	0.5725	0.4414	1.3000	0.1950	-0.2927	1.4377
Province 3 (dummy)	-1.4150	0.5059	-2.8000	0.0050	-2.4066	-0.4234
Province 4 (dummy)	0.2630	0.2413	1.0900	0.2760	-0.2099	0.7358
Constant	13.31	12.38	1.08	0.2820	-10.95	37.56
σ^0	1.3792	0.1030			1.1914	1.5966
σ^1	0.9551	0.0521			0.8582	1.0630
ρ^0	-0.4266	0.1966			-0.7290	0.0152
ρ^1	0.0337	0.3299			-0.5466	0.5922

Std. Err. = standard error.

Note:

P = P value is the smallest level of significance for which the observed sample statistic tells us to reject the null hypothesis.

z = The standard normal distribution is the normal distribution where the mean is zero and the standard deviation is one.

Source: Authors' calculations.

- Households with more educated household heads are more likely to join the contract.
- Households with larger family size are more likely to join the contract.
- Households closer to the highway are more likely to join the contract.

Table 6.9 shows the estimation results for the profit functions with and without contract, based on which we can estimate the sample farmers' profits under contract and outside contract. With the estimated results we can then calculate contract and noncontract farmer's premiums from joining the contract and compare their profitability under contract and outside contract. The results are summarized in Table 6.10.

Table 6.9 Profit Functions under Contract and Without Contract

Variables	Coefficient	Std. Err.	z	P>z	Confidence Interval (95%)	
Profit without contract (log)						
Rice price	2.8848	0.9549	3.0200	0.0030	1.0132	4.7564
Wages	-0.8163	0.1958	-4.1700	0.0000	-1.2000	-0.4326
Seed price	-2.4547	0.7967	-3.0800	0.0020	-4.0163	-0.8932
Chemical fertilizer price	-0.1323	0.9476	-0.1400	0.8890	-1.9896	1.7250
Compost price	-0.1384	0.2415	-0.5700	0.5670	-0.6118	0.3350
Irrigation price	-0.2866	0.2003	-1.4300	0.1520	-0.6791	0.1059
Machinery price	-0.7162	0.1970	-3.6400	0.0000	-1.1024	-0.3301
Own land	-0.0937	0.1947	-0.4800	0.6300	-0.4752	0.2878
Fixed production asset	0.0488	0.0285	1.7100	0.0870	-0.0071	0.1047
Province 2 (dummy)	-0.1505	0.5869	-0.2600	0.7980	-1.3008	0.9998
Province 3 (dummy)	0.6623	0.4471	1.4800	0.1380	-0.2139	1.5385
Province 4 (dummy)	-0.5076	0.3120	-1.6300	0.1040	-1.1192	0.1040
Contract experience (Yes = 1; No = 0)	0.3038	0.2796	1.0900	0.2770	-0.2442	0.8517
Constant	1883.80	9.21	204.53	0.0000	1865.75	1901.85
Profit under contract						
Rice price	0.3290	0.3558	0.9200	0.3550	-0.3684	1.0265
Wage	-1.1878	0.1604	-7.4100	0.0000	-1.5021	-0.8734
Seed price	0.3698	0.3843	0.9600	0.3360	-0.3834	1.1231
Chemical fertilizer price	-0.5378	0.6530	-0.8200	0.4100	-1.8178	0.7421
Compost price	-0.0307	0.1922	-0.1600	0.8730	-0.4074	0.3460
Irrigation price	-0.4034	0.1274	-3.1700	0.0020	-0.6531	-0.1536
Machinery price	-0.4166	0.1464	-2.8500	0.0040	-0.7036	-0.1296

continued on next page

Table 6.9 continued

Variables	Coefficient	Std. Err.	z	P>z	Confidence Interval (95%)	
Own land	-0.1504	0.1755	-0.8600	0.3910	-0.4943	0.1936
Fixed production asset	0.0040	0.0204	0.2000	0.8430	-0.0360	0.0441
Province 2 (dummy)	-0.9086	0.3405	-2.6700	0.0080	-1.5759	-0.2413
Province 3 (dummy)	0.8378	0.6411	1.3100	0.1910	-0.4188	2.0943
Province 4 (dummy)	0.3871	0.2141	1.8100	0.0710	-0.0324	0.8067
Constant	1885.31	6.69	282.01	0.0000	1872.21	1898.42

Std. Err. = standard error.

Note:

P = P value is the smallest level of significance for which the observed sample statistic tells us to reject the null hypothesis.

z = The standard normal distribution is the normal distribution where the mean is zero and the standard deviation is one.

Source: Authors' calculations.

- For all the sample farmers on average, joining the contract would tend to raise profit by 0.43 million riel.
- For the sample contract farmers, joining the contract would raise their average profit by nearly 1 million riel.
- For the sample former-contract farmers on average, had they joined the contract, their profits would have been 0.18 million riel lower than their actual profits.

Table 6.10 Profitability Comparison based on Switching Regression

Farmer Type	Profit Premium from joining contract ^a (million riel)	Profit Difference under contract ^b (million riel)	Profit Difference outside contract ^c (million riel)
All farmers (II)	0.43***	n.a.	n.a.
Contract farmers (Π_1 , $\Lambda_{1,1}$, and $\Lambda_{0,1}$)	0.99***	0.03***	-0.52***
Former-contract farmers (Π_0 , $\Lambda_{1,0}$, and $\Lambda_{0,0}$)	-0.18**	-0.03***	0.51***
Never-contract farmers (Π_0 , $\Lambda_{1,0}$, and $\Lambda_{0,0}$)	0.17	-0.03***	-0.57***

***1% significance level; **5% significance level; *10% significance level.

Notes:

^a Each type of farmer's average profits under contract minus their average profits without contract.

^b Each type of farmers' average profits under contract minus the average profit of all the sample farmers under contract.

^c Each type of farmers' average profits outside contract minus the average profit of all the sample farmers outside contract.

Source: Authors' calculations.

- For the sample never-contract farmers on average, had they joined the contract, their profits would have been increased by 0.17 million riel, but the difference is not statistically significant. Note that the small sample size (27 never-contract farmers only) may be a factor affecting the significance level.
- Under contract, the sample contract farmers on average have higher profits than the sample former-contract and never-contract farmers; their average profit under contract is 0.03 million riel above the average of all the sample farmers.
- Outside contract, the sample former-contract farmers on average have higher profits than the sample contract and never-contract farmers; their average profit outside the contract is 0.51 million riel above the average of all the sample farmers.

6.7 SUMMARY

Contract farming can provide stable market access, credits, extension services, infrastructure, and other benefits to promote agricultural development. However, contract farming also has drawbacks such as limiting farmers' flexibility in choosing farming practices, increasing risks, and reducing farmers' bargaining power. In the process of establishing and implementing contracts the challenges of asymmetric information and coordination failures between farmers and the contractor are also faced.

Based on the data provided by a survey of Cambodian rice farmers, we use different approaches (including simple mean comparisons, p-score comparisons, and switching regression comparisons) to examine the impact of contract farming on farmers' performance.

We first use the simple mean test to compare the average performance of contract, former-contract, and never-contract farmers. The results show that compared to never-contract farmers, contract and former-contract farmers have larger family sizes and farm sizes. Their household heads are older, more educated, and less likely to be female. They are richer farmers with more assets like plows, pumps, bikes, motorbikes, livestock, and TVs and have a higher monthly expenditure per person. Their credits are mainly from MFIs and seed credit comes from AKR, and they rely less on informal sector lenders (i.e., moneylenders and family members or relatives). They have more income from non-rice crops. They have larger rice fields and use a higher percentage of their rice fields for commercial operations. With respect to commercial operations, they have higher rice prices and revenues, a higher percentage of non-cash costs in total production costs

because of the use of more family labor, and they spend less on chemical fertilizer, compost, and irrigation.

The simple mean comparisons show that compared to former-contract farmers, contract farmers have larger family sizes and farm sizes and younger household heads. They rely more on seed credits but less on fertilizer credits and credits from family members or relatives. Their farms are further away from the market. They have larger rice fields and use a higher percentage of their rice fields for commercial operations. With respect to commercial operations, they have higher rice prices but lower revenues because of lower yields; they spend more for labor cost producing the same amount of rice mainly because of their higher non-cash costs from the use of family labor; and they use less exchanged labor (in percentage terms) than former-contract farmers.

Finally, the simple mean comparisons show that contract farmers have higher average profits as well as cash profits than never-contract farmers, and they have higher average profits but lower average cash profits than former-contract farmers. However, none of these differences are statistically significant at 10%.

Although the simple mean comparisons show that contract farmers have higher average profits than noncontract farmers, we cannot use this result to conclude that contract farming improves profitability, because contract farmers' higher profit may not be due to contract farming but could be caused by farmers' selection bias.

To account for selection bias, we use p-score comparisons to examine the impacts of contract farming on farmers' performance. The results show that contract farmers have higher average rice prices, revenues as well as cash profits, than never-contract farmers in their entire operations including both commercial rice farming and rice farming for self-consumption. The p-score comparisons show that contract farmers have lower average profit (i.e., cash profit minus non-cash costs) than never-contract farmers, which is mainly due to their use of more family labor. Note that we use the cost of hired labor to estimate the shadow value of family labor, which may overestimate contract farmers' non-cash labor costs. In addition, cash profit is a better measure of the total value-added obtained by farmers' from their farming activities.

As there are only very few never-contract farmers reporting their commercial activities, we are unable to use the p-score approach to compare

the performance of contract and never-contract farmers in commercial operations. Fortunately, we are able to do so for contract and former-contract farmers. The p-score comparisons show that although contract farmers have higher rice prices than former-contract farmers in commercial operations, they nevertheless have lower revenues because of lower yields. The results also show that in commercial operations contract farmers have lower profits as well as cash profits than former-contract farmers, but the differences are not statistically significant. Thus, former-contract farmers' profitability does not appear to be affected by their choices of not joining the contract. This result shows that contract farming may be a useful experience to help farmers develop into independent commercial farmers.

As p-score comparison cannot correct hidden bias, we use a selection model (i.e., the endogenous switching regression) to further refine the comparison. The switching regression comparisons also allow us to examine each type of farmers' benefits from contract farming and compare their farming performance with and without the contract. The results show that on average, the sample farmers would increase their profits by joining the contract, but the impacts are different for each group. The sample contract farmers appear to be able to improve their profits significantly by joining the contract, while the sample former-contract farmers appear to have lower profits under contract farming. The sample never-contract farmers would have slightly higher profits under contract farming, but the difference is not statistically significant.

The results from switching regression comparison also show that under contract farming, the sample contract farmers would have higher average profits than the sample former- and never-contract farmers, but their average profits without contract would be similar to the sample never-contract farmers and lower than the sample former-contract farmers.

The switching regression also identifies factors affecting farmers' choices regarding joining the contract. The results show that farmers with larger family size, with younger and more educated household heads, with less asset value, and farmers with farm location closer to the highway are more likely to join the contract.

6.8. CONCLUSIONS AND RECOMMENDATIONS

Overall, the results show that rice contract farming by AKR brings a number of benefits to smallholder farmers in Cambodia. Through contract farming, there are new income-earning opportunities to produce high-

value rice for the export market with minimal expense by the public sector. By introducing new institutional arrangements taking advantage of the existing commune structure established during the socialist regime, AKR successfully establishes farmers' organizations and uses them effectively to deliver credit for seeds and to extend organic rice farming practice, including integrated farming practice, to farmers. Most importantly, by promoting farming practices in which the poor in remote areas have a comparative advantage, AKR successfully facilitated coordination and intermediation to provide market access for farmers living in remote areas where organizational capacity in the public sector is weakest.

The characteristics of farmers who benefited the most are farmers with larger land sizes, larger family sizes, younger household heads, and farmers with a higher level of education. Progressive farmers living near the highway are likely to be the first group joining contract farming. However, it is interesting to note that this same group of farmers is also more likely to leave contract farming early as there are more market opportunities in areas where infrastructure is more developed. Since production under contract is restricted and, in particular, AKR restricts the use of agrochemicals to address the demand in the export market, farmers who have access to the local market for chemical rice moved on to intensify their farming practices to increase profit. It could be said that by undergoing organic contract farming, farmers were empowered to become independent farmers who intensify farming systems in a more sustainable way than farmers who have never undergone contract farming.

For farmers who live far away from the highway or live near the forest where soil fertility is good, arrangements under AKR to produce organic rice for export appear to be appropriate and long-lasting. From the point of view of poverty, this is a highly positive outcome for farmers in remote areas, as contract farming brings to them market access along with the introduction of sustainable farming practice.

Nevertheless, the results point to the fact that contract farming by AKR is not inclusive of the poorest farmers typically with land size below 1 hectare and with lower levels of education. Public sector attention will be required for this group of farmers. Overall, contract farming under AKR is not without problems and public attention may be required in the areas of empowering farmers' groups to increase bargaining power with this firm that is currently holding a monopsony position. More firms should be encouraged to enter into contract farming.

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APPENDIX 1

Switching Regression Methodology

Consider the following model that describes farmers' choices of joining the contract and their performance with and without the contract:

If $\gamma Z_i + u_i > 0$, farmer i chooses to join the contract, which is described by $I_i = 1$;

If $\gamma Z_i + u_i \leq 0$, farmer i chooses not to join the contract, which is described by $I_i = 0$;

Farmer i 's profitability with the contract ($I_i = 1$) is $y_{1i} = \beta_1 X_{1i} + \varepsilon_{1i}$;

Farmer i 's profitability without the contract ($I_i = 0$) is $y_{0i} = \beta_0 X_{0i} + \varepsilon_{0i}$;

In the model, Z_i is a vector of farm characteristics that affect farmers' decision of joining the contract; X_{1i} and X_{0i} are two vectors of farm characteristics that affect farmers' performance under the contract and without the contract; and y_{1i} and y_{0i} are dependent variables measuring farmers' profitability. γ , β_1 and β_0 are vectors of parameters subject to estimation. u_i , ε_{1i} , and ε_{0i} are three random error terms that follow trivariate normal distribution.

After the parameters are estimated, we can calculate

$$xb_{1i} = E(y_{1i} | x_{1i}) = x_{1i} \beta_1 \quad (1)$$

$$xb_{0i} = E(y_{0i} | x_{0i}) = x_{0i} \beta_0 \quad (2)$$

$$yc_{1_{-1i}} = E(y_{1i} | I_i = 1, x_{1i}) = x_{1i} \beta_1 + \sigma_1 \rho_1 f(\gamma Z_i) / F(\gamma Z_i) \quad (3)$$

$$yc_{0_{-1i}} = E(y_{0i} | I_i = 1, x_{1i}) = x_{1i} \beta_0 + \sigma_0 \rho_0 f(\gamma Z_i) / F(\gamma Z_i) \quad (4)$$

$$yc_{0_{0i}} = E(y_{0i} | I_i = 0, x_{0i}) = x_{0i} \beta_0 - \sigma_0 \rho_0 f(\gamma Z_i) / [1 - F(\gamma Z_i)] \quad (5)$$

$$yc_{1_{0i}} = E(y_{1i} | I_i = 0, x_{0i}) = x_{0i} \beta_1 - \sigma_1 \rho_1 f(\gamma Z_i) / [1 - F(\gamma Z_i)] \quad (6)$$

xb_{1i} represents the unconditional expectation of farmers' performance under the contract; xb_{0i} represents the unconditional expectation of farmers' performance without the contract; $yc_{1_{-1i}}$ represents the conditional expectation of contract farmers' performance under the contract; $yc_{0_{-1i}}$

represents the conditional expectation of contract farmers' performance without the contract; $yc_{0_{0i}}$ represents the conditional expectation of non-contract farmers' performance without the contract; and $yc_{1_{0i}}$ represents the conditional expectation of noncontract farmers' performance with the contract. σ_1 and σ_0 are the standard errors of ε_{1i} and ε_{0i} ; ρ_1 is the correlation coefficient between ε_{1i} and u_i ; and ρ_0 is the correlation coefficient between ε_{0i} and u_i .

Indicators for Premiums of Joining the Contract

Based on equations (1) to (6), three indicators can be constructed to compare farmers' profitability with and without the contract.

$$(1) \quad \Pi = xb_{1i} - xb_{0i}$$

According to equations (1) and (2), Π is equal to a general farmer i 's (irrespective of his choice of contract farming) expected performance under the contract minus his expected performance without the contract. The mean of Π measures farmers' average profitability premiums from joining the contract.

$$(2) \quad \Pi_1 = yc_{1_{1i}} - yc_{0_{1i}}$$

According to equations (3) and (4), Π_1 is equal to a sample contract farmer i 's expected performance under the contract minus his expected performance without the contract. The mean of Π_1 measures the sample contract farmers' average profitability premiums from joining the contract.

$$(3) \quad \Pi_0 = yc_{1_{0i}} - yc_{0_{0i}}$$

According to equations (5) and (6), Π_0 is equal to a sample non-contract farmer i 's expected profitability under the contract minus his expected profitability without the contract. The mean of Π_0 measures the sample noncontract farmers' average profitability premiums from joining the contract.

Indicators for selection bias

$$(4) \quad \Lambda_{1_{-1}} = yc_{1_{1i}} - xb_{1i} \text{ and } \Lambda_{0_{-1}} = yc_{0_{1i}} - xb_{0i}$$

According to equations (1) and (3), $\Lambda_{1_{-1}}$ compares a sample contract farmer i 's average profitability under the contract (measured by $yc_{1_{1i}}$) to the

profitability of a general farmer (with the same characteristics) under the contract. A positive mean of Λ_{1-1} indicates that under the contract, farmers who actually joined the contract tend to have higher profitability than those who did not.

According to equations (2) and (4), Λ_{0-1} compares a sample contract farmer i 's average performance without the contract (measured by yc_{0-1i}) to the profitability of a general farmer without the contract. A positive mean of Λ_{0-1} indicates that outside the contract, farmers who actually joined the contract would also have higher profitability than those who did not.

$$(5) \quad \Lambda_{1-1} = yc_{0-0i} - xb_{0i} \text{ and } \Lambda_{1-0} = yc_{1-0i} - xb_{1i}$$

According to equations (2) and (5), Λ_{0-0} compares a sample noncontract farmer i 's average profitability outside the contract (measured by yc_{0-0i}) to the profitability of a general farmer (with the same characteristics) outside the contract. A positive mean of Λ_{0-0} indicates that outside the contract, farmers who did not join the contract tend to have higher profitability than those who did.

According to equations (1) and (6), Λ_{1-0} compares a sample noncontract farmer i 's average performance outside the contract (measured by yc_{1-0i}) to the profitability of a general farmer outside the contract. A positive mean of Λ_{1-0} indicates that under the contract, farmers who did not join the contract tend to have higher profitability than those who did.

Λ_{1-1} , Λ_{0-1} , Λ_{0-0} , and Λ_{1-0} measure farmers selection bias on contract farming. There are 4 patterns.

$$(1) \quad \Lambda_{1-1} > 0; \Lambda_{1-0} < 0 \text{ and } \Lambda_{0-1} > 0; \Lambda_{0-0} < 0$$

This situation indicates that the sampled contract farmers tend to have higher profitability no matter whether they are under the contract or outside the contract. That is, better farmers tend to choose to join the contract.

$$(2) \quad \Lambda_{1-1} > 0; \Lambda_{1-0} < 0 \text{ and } \Lambda_{0-1} < 0; \Lambda_{0-0} > 0$$

This situation indicates that the sampled contract farmers tend to have higher profitability under the contract but lower profitability outside the contract. That is, farmers who have comparative advantage in contract farming tend to choose to join the contract, while those who have

comparative advantage outside the contract tend to choose to stay outside the contract.

$$(3) \Lambda_{1-1} < 0; \Lambda_{1-0} > 0 \text{ and } \Lambda_{0-1} > 0; \Lambda_{0-0} < 0$$

This situation indicates that the sampled contract farmers tend to have lower profitability under the contract but higher profitability outside the contract. This is an unlikely scenario because it implies that farmers who do not have comparative advantage in contract farming tend to choose to join the contract, while those who do have comparative advantage in contract farming nevertheless tend to choose to stay outside the contract.

$$(4) \Lambda_{1-1} < 0; \Lambda_{1-0} > 0 \text{ and } \Lambda_{0-1} < 0; \Lambda_{0-0} > 0$$

This situation is the exact opposite to the first one. It indicates that the sampled contract farmers tend to have lower profitability no matter whether they are under the contract or outside the contract. That is, better farmers tend to choose to stay outside the contract.

PART III

Traceability Systems and Global Agribusiness Trade Regime

7. Standards and Agricultural Trade in Asia

Daniele Giovannucci and Timothy Purcell¹



7.1 INTRODUCTION

In developing countries, the markets for agrifood products are changing at an unparalleled pace in modern history, becoming increasingly open and homogenized toward international standards. New distribution channels, dominated by larger firms, are imposing even higher performance demands, including social and environmental standards, throughout the value chains. Traditional ways of doing business are often no longer adequate, resulting in new challenges for small and medium-sized farms. Failure to acquire the technical know-how and financial resources to incorporate standards such as quality assurance, safety, and traceability, marginalizes many small and medium-sized farms and agroenterprises.

Until the late 1980s, rural development was typically state-focused, with public institutions controlling the systems and infrastructure for agri-market inputs and outputs. These institutions were, for the most part, unceremoniously scrapped as their shortcomings became evident, free-market theories became prominent, and structural adjustment took hold. Their role in supporting smaller, more marginalized or remote producers, however, was important in facilitating equitable access to information and markets. Consequently, their absence in poorer regions has exacerbated market failures and left a vacuum that is not often adequately filled by the private sector.

Through the lenses of value chain theory and institutional economics, the interrelationships of private sector agricultural production and trade with the emerging processes of civil governance are becoming better understood. From such understanding can emerge the necessary innovation and support required to provide sustainable solutions to the challenges of necessary capacity building or long-term financing required by smaller farmers and rural entrepreneurs who want to participate in the value chain. Without effective public and civic institutions, the ability of smaller farms and enterprises to participate is reduced.

¹ First published as Giovannucci, D. and T. Purcell. 2008. "Standards and Agricultural Trade in Asia." ADBI Discussion Paper No. 107. Tokyo: Asian Development Bank Institute.
Available: <http://www.adbi.org/files/dp107.standards.agricultural.trade.asia.pdf>

7.2 NEW DEVELOPMENTS AFFECT AGRICULTURAL PRODUCERS' MARKET ACCESS

Improved logistics, faster communication, and fewer trade barriers have made markets increasingly open and homogenized toward international standards. Large farming systems are incorporating greater skills and investing in technology and infrastructure to enable more controlled large-scale production that is difficult for smaller farmers to achieve. Market access challenges faced by smaller farmers apply both to international and national markets, as the structure of distribution channels shifts away from small local markets toward, for example, supermarkets.

Supermarkets typically procure steady supply and large volumes of products from suppliers. Joining a supermarket's procurement system may require heavy capital and more skilled labor force. Agricultural standards also play an important role in these procurement systems. Agricultural standards evolved over the course of many years and were in essence codified publicly by regular accepted use, but the last decade or so has seen dramatic changes. New and often private standards are demanded by buyers in order to meet their value chain management needs or to reduce their exposure to risk.

How standards drive developments in the global agrifood system is intimately linked with functions of governance within the value chain; that is, conditions for participation in the chain are set, implemented, monitored, and enforced. In the past, these rules mainly dealt with meeting basic cost parameters and guaranteeing supply. However, as outlined by Giovannucci and Reardon (2000), standards have now become tools for product differentiation, playing new roles as strategic tools that are used for market penetration, safety assurance, traceability, quality control, incorporation of social and environmental guidelines, and even the definition of product niches.

Smallholders in the supply chain often lack the internal capacity and the economies of scale to establish effective quality assurance and traceability systems. Often, smallholders cannot meet these standards on their own (Reardon and Berdegúe 2002a, 2002b). Small enterprises and producers, especially sectors that are export-dependent, may be marginalized unless they can make standard compliance cost effective and guarantee traceability for the buyers. Contractual arrangements are often utilized to resolve the uneven relationships between many small suppliers and a few large buyers.

7.2.1 Global Developments Driving New Trade Processes

Today, because there is great exposure and public risks when standards fail to maintain food safety or when they permit social and environmental harm, they are driving a number of new processes such as Hazard Analysis at Critical Control Points (HACCP) and sustainability standards such as organics. The globalization of these value chains and the enormous volumes and concentrations of buying power can mean dramatic consequences for thousands or even millions of people. Food contamination scares (e.g., involving *salmonella* or *E.coli*) have demonstrated how the failure of standards can cripple an entire subsector, even across developed nations such as the United States (US) and the United Kingdom. As a result, not only firms but also governments and consumers are increasingly concerned. This concern is being progressively translated as higher requirements for market entry, including food safety, traceability, higher quality, and even certifications of process. These requirements are being driven by changes in three major areas:

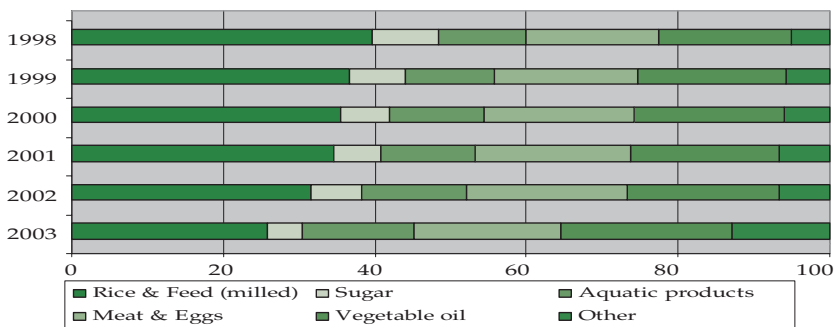
- (i) *new consumer environment*: characterized by a predominant interest in personal health and increasing doubt in the ability of government to ensure food safety;² increased transparency and communications led to more information and greater concern about the social and environmental conditions in the place of origin.
- (ii) *new business environment*: increasing concentration of suppliers, intermediaries, and retailers stimulates further differentiation and intense drive for new supply sources and greater efficiencies in costs and logistics in the agrifood business. Global companies set standards above minimum levels and requiring third-party certification and traceability in response to risks of civil or criminal responsibility (Fulponi 2005) and voluntarily reported on social and environmental issues within their firms. Many used independent audits to help ensure their transparency and credibility.
- (iii) *new regulatory environment*: to manage the deepening global trade, governments impose new barriers to entry in the form of public standards. In some cases, governments resort to regulations such as the bioterrorism laws in the US and the Maximum Residue Levels or genetically modified organism (GMO) restrictions which stimulated the evolution of numerous standards in the European Union (EU); the private sector also added its own standards.

² One of the world's most prominent medical associations warned of the dire human health consequences of the increasing resistance to antibiotics in the United States where only 12% of all antibiotics are used for humans and the remaining 88% are routinely fed in intensive livestock operations (*New England Journal of Medicine* 1999 such as work by Wegener, H. 1999. The Consequences for Food Safety of the Use of Fluoroquinolones in Food Animals). That journal has also noted that a likely result is that antibiotic-resistant infections had increased 800% between 1992 and 1997.

7.2.2 Standards Increasingly Set the Rules of the Game

Standards offer quality and safety assurance, as well as differentiate and define product categories. In addition to food safety, taste, cosmetic quality, and nutritional value, they increasingly involve process requirements such as environmental impact, worker health and safety, animal welfare, and fairness to primary producers. In some cases, suppliers are required to provide reasonable assurance of social and environmental benefits that range from an International Organization for Standardization (ISO) series to HACCP to organics. Such requirements can either facilitate market penetration or act as barriers to entry. Accordingly, standards are the new rules and they are evolving dynamically. Indeed, a common argument for private standards is that firms believe they can more quickly respond to market needs by controlling their own standards. Understanding and meeting them is becoming increasingly challenging.

Figure 7.1 Output Structure in PRC Food-Processing Industries, Percentage of Total 1998–2003



PRC = People's Republic of China.

Source: Adapted from data of Chinese Food Industries Year Book, 1999–2004 in Lu (2005).

As incomes grow, so does the tendency to consume perishable foods such as meat, dairy, and aquatic products that are more susceptible to life-threatening diseases. As greater communication and trade influence consumption patterns to resemble those of US and European protein-based diets, governments have become more sensitive to agricultural safety.³

³ For example, outbreaks of avian influenza in Southeast Asia during 2004 and 2005 halted the production and trade in poultry products, affected suppliers of feed and other inputs, severely reduced tourism, and seriously affected other parts of the economy, not least of all the deaths of about 204 people up to November 2007. Estimates of the economic loss are around 1.5% of gross domestic product for some of the affected countries.

These shifts mean more pressure for producers and processors. In the People's Republic of China (PRC), the total number of processors shrunk by two-thirds in the past decade as food processing has shifted from traditional, lower-risk products to meat, dairy, and aquatic products and horticultural produce that require higher standards and greater investments (Figure 7.1).

Experience from other regions points to similar difficulties. Jaffee and Henson (2004) note that the rejection of agricultural imports from noncompliance cost low- and middle-income countries about \$1.6 billion in 2000–2001. In 2002, Brazil, the PRC, Thailand, Turkey, and Viet Nam accounted for nearly 60% of the EU's rejections from non-EU sources (Jaffee and Henson 2004). Statistics from the US Department of Agriculture and the Food and Drug Administration note a rising trend in such food safety problems, with reports almost doubling from 1994 to 2004 (Center for Science in the Public Interest 2007), and these US agencies plan to advocate preventive controls, including higher import safety standards. Standards take different forms. They may be set in commercial legal codes and subject to fines if transgressed, they may be internationally recognized and widely used even though they have no specific legal basis, or they may be private, firm-specific requirements (Table 7.1). However, rewards await exporting countries that have developed their compliance capacities. The *China Daily* (2011) reported that with the country's accession to the World Trade Organization (WTO), the PRC's exports of agricultural products tripled to \$49 billion in 2010, from \$16 billion in 2001, representing a 13.3% year-on-year increase on an annual basis.

Table 7.1 Characterizing Different Types of Standards

Type of Codification		Legal Codification	Internationally Agreed	Regionally Specific	Firm Specific
Type of standard	Product	Food hygiene standards	<ul style="list-style-type: none"> • Codex Alimentarius • Grades of wheat • Moisture level for coffee beans 	<ul style="list-style-type: none"> • EU MRLs • EU GMO limits 	Chiquita residue and size standards
	Process	Workplace health and safety standards	<ul style="list-style-type: none"> • ISO9000 (quality) • SA8000 (labor) • Fair Trade 	<ul style="list-style-type: none"> • BRC • ASEAN-GAP 	Starbucks sourcing practices

ASEAN = Association of Southeast Asian Nations, BRC = British Retail Consortium, EU = European Union, GAP = good agricultural practice, GMO = genetically modified organism, MRL = maximum residue level.

Source: Adapted with changes and additions from Kaplinsky and Morris (2001).

Standards can be enforced by participants within the chain as well as by external agencies. From within the chain, the key sanction is excluding a supplier from participating, while well-performing suppliers can be favored with longer-term contracts and higher prices (Kaplinsky and Morris 2001). Sanctions may also be exercised outside the chain, and many governments have extensive bureaucracies checking compliance with legislation and even prosecuting offenders. In recent years, nongovernment organizations (NGOs) have grown into an important sanctioning force. Boycotts and publicity campaigns, or the threat of them, have also forced many leading firms to change the way they produce or delist particular suppliers (Kaplinsky and Morris 2001).

What is common to value chains is the increasing concentration of power among a few actors, leading to increased horizontal and vertical coordination. The considerable purchasing power of large-scale retailers in particular enables them to set various private standards that are often more demanding than the public safety standards. Since standards can be influenced considerably by both public and private sectors, producers and processors of agricultural products have to serve many masters.

According to a report by the Institute of Grocery Distribution (IGD 2012), the PRC (\$964 billion) has overtaken the US (\$904 billion) as the world's largest food and grocery retail market by the end of 2011. The BRIC nations (Brazil, the Russian Federation, India, and the PRC) are expected to be in the top five grocery markets with India displacing Japan in the third place by 2015. The retail food industry increasingly resembles the definition of a classic oligopolistic industry. At the top are large multi-unit retailers that tend to dominate consumer food distribution in many countries. For example, in the US, the top five supermarket chains accounted for over 40% of retail food sales in 2000, up from 20% in 1993 (Busch and Bain 2004).

The largest are powerful multinationals and include US-based Walmart with more than 5,000 mostly hypermarket-type stores and France-based Carrefour with more than 11,000 stores of varying formats. As reference, their annual revenue is greater than the total value of any country's agriculture sector. According to Fortune 500 Magazine cited in CNNMoney (2012), Walmart is the largest company in the US in terms of revenues at \$422 billion in 2011 with 2.2 million employees. Such dominant players are the major drivers behind a staggering global flow of commodities, products, information, and finance that

coordinate the activities of hundreds of millions of farmers and affect billions of consumers.⁴

7.2.3 Producers and Small and Medium-Sized Enterprises Face Difficult Hurdles

Developing country producers and small and medium-sized enterprises (SMEs) face a number of hurdles to participate effectively in higher-value trade. An International Food Policy Research Institute (IFPRI) article (Hazell 2004) refers to the often stated need for better infrastructure, link to markets, and credit (among others), and notes that, nonetheless, these still do not sufficiently address the problems of compliance with an increasingly complex standards environment.

Project effectiveness reviews for signatories of the Lomé Convention from Africa, the Caribbean, and the Pacific looking at quality and conformity in the fruit and vegetables subsectors note that private standards present formidable technical barriers that have a negative effect on smallholders. Exporters select only the best-performing smallholders to be organized into groups which are expected to manage its traceability systems. Moreover, weaker farmers are often excluded. For example, one of Zambia's largest horticulture exporters sources only one product from smallholder producers.⁵ The exporter fears that if the smallholder cooperative cannot meet the required standards, it may risk losing its Global-Good Agricultural Practices (GAP) certification.

Institutional structures are necessary to achieve a form of vertical coordination that can overcome transactions costs and standards barriers that smallholders face. In the Philippines, the growing popularity of contract hog farming allows feed millers to use smallholders' labor and land to fatten hogs at low cost. Such small-scale livestock operations have thrived in many regional markets. As that changes and large-scale industrial operations become ever more dominant, small enterprises without the support of institutional structures and organizations are less likely to survive.

⁴ As an example, while there are around 3.2 million farmers and 160 million consumers in Europe, there are, in fact, only 600 supermarket companies and 100 wholesale distributors supplying the majority of the markets (Grievink 2003). While most of the major supermarket chains have their own integrated distributor systems, the smaller chains and independents rely on outsourcing their purchasing and distribution systems to independent wholesalers. In Australia, Woolworths and Coles control 78% of supermarket business. Independent Grocers of Australia ranks a distant third controlling 14% (AFGC and AT Kearney Australia 2011). The concentration of buying power in a few companies makes it difficult for smallholders from developing countries to gain access to such high-value markets.

⁵ The exporter only contracts for baby corn, a product that is less likely to result in pesticide residues.

7.2.4 The Growth of New Distribution Channels

Recent studies point to the shift in marketing channels available to producers and the rapid rise of supermarkets in developing countries (Reardon 2005; Fulponi 2005; Reardon et al. 2003; Moustier et al. 2005). The 1990s saw the emergence of supermarkets as a major form of retailing in many developing countries (Box 7.1), becoming dominant players in many Latin American countries with the trend moving rapidly in East and Southeast Asia and more slowly in South Asia (Figure 7.2). This development is substantially transforming the nature and the composition of domestic agrifood commerce as well as regional and overseas trade.

Box 7.1 Supermarkets Emerge in the United States and Explode in Latin America and Asia

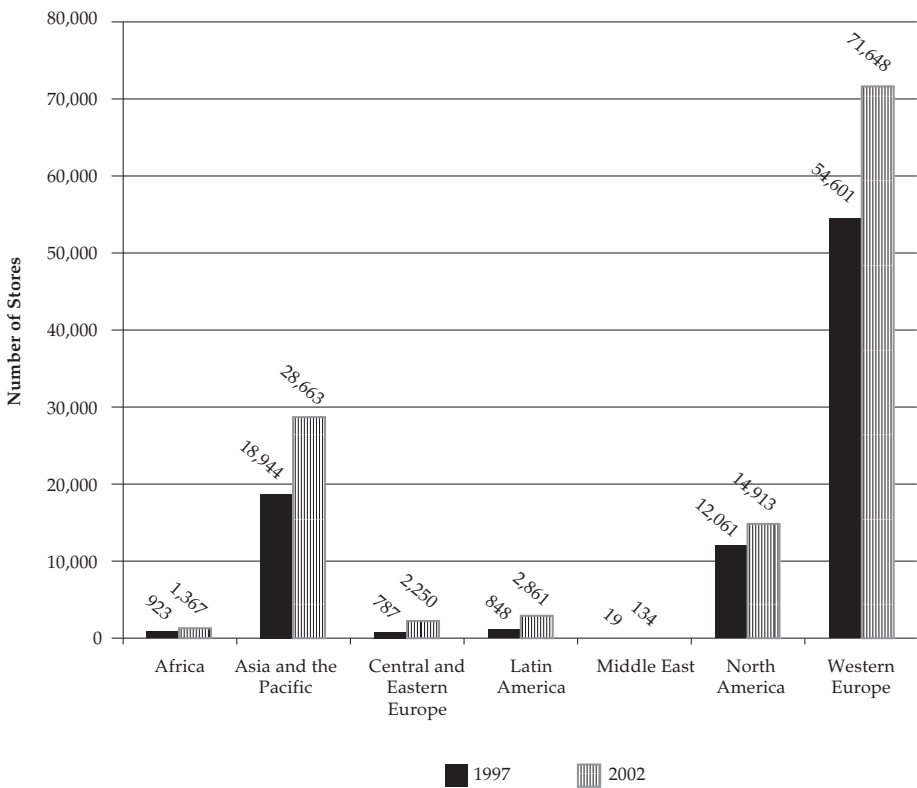
Developments around the supermarket concept are representative of trends experienced in other multi-store retail formats. The supermarket—self-serve, larger scale retailer often with more than one checkout counter—emerged in the United States (US) about 75 years ago.

Between 1925 and 1955, supermarkets captured more than half of US grocery sales. By the 1980s, they had become the dominant food distribution channel in the US. Today Germany, the United Kingdom, and France show supermarket shares of food retail at 70%–80%. This business model, now refined, has strong implications for domestic and regional food suppliers.

Sources: Reardon et al. 2003; Reardon and Gulati. 2005.

It is important to understand the effects of this market transformation, not only on producers and value chains but also on the entire agrifood system, since it affects costs and distributional issues from the farm to the table. Within these larger trends, several important developments can be observed:

- (i) increasing demands for higher levels of farmer performance in quality, process, and financial capacity to invest in technology and operating capital;
- (ii) greater centralization of retail procurement with the advent of the specialized, sophisticated multi-country logistics management wholesaler replacing traditional wholesalers; and
- (iii) greater use of contracts and private systems to identify and reward preferred suppliers.

Figure 7.2 Growth in Supermarkets on a Regional Basis, 1997–2002

Source: Planet Retail. 2006.

Asia is forecast to grow to 41% of the global food retail market by 2020 while Europe will comprise 30% and the North American Free Trade Agreement area will shrink to 21% (IGD calculations). Multiple store retailers will be an important part, particularly with the liberalization of emerging markets and foreign direct investment. These include small-scale convenience stores, such as those associated with gasoline stations, supermarkets, and full-service retailers such as hypermarkets.

Developing countries are not exempt from the trend toward supermarkets. South America, parts of Europe, and advancing East Asian economies saw their supermarket share of food retail, grow from about 10%–20% in the early 1990s to more than 50% just a decade later (Reardon and Berdegue 2002a, 2002b). The supermarket sector in Asia is now growing even faster

than in Latin America (Reardon et al. 2003, Reardon and Gulati 2005). The authors, citing A.C. Nielsen statistics, note that supermarkets in Asian countries, such as those in the Republic of Korea, the Philippines, and Taipei, China, have achieved an average 63% share of the food retail in those countries (excluding the fresh segment, i.e., meat, fish, fruits, and vegetables). Applying the calculations of Reardon et al. in Latin America, one can estimate that supermarkets' share of the fresh segment in Asia is approximately half of their total share in packaged foods. In some countries, the growth has been even more rapid. Indonesia's supermarkets' share of food retail was negligible before 1998, shot up to 30% by 2005 of the total (Natawidjaja et al. 2006). In the PRC, supermarkets did not exist prior to 1990, but has now overtaken the US in terms of market value.

The dominance of these new retail formats has resulted in the emergence of demanding new procurement channels and the decline of smaller informal markets that could more readily accept both small quantities and inconsistent qualities of foods from farmers and intermediaries. In Viet Nam and the PRC, as supermarkets develop fast in cities, government policies favor centralization of food distribution and the reduction of street vending and informal markets (Moustier et al. 2005; Reardon 2005).⁶

The demands in domestic markets of less developed nations increasingly resemble those of export channels. Latin America, for example, is a primary exporter of fruits and vegetables, yet in recent decades, supermarkets sold about three times more than were exported from the region. Reardon et al. (2005) and Vander, van der Wal, and Oldenziel (2006) also claim that the increasing market domination by big corporations and multinational supermarket chains influences the prices producers receive and the conditions under which they must produce. The consolidation of procurement implies great challenges for small agriproducers. For instance, it made more business sense for supermarkets in Bangladesh to order container loads of vegetables from Singapore than to contract thousands of small Bangladeshi farmers.

Supermarket channels have demanding private standards similar to export requirements for size, color, safety, consistency, volume, packaging, labels, etc., which implies the need for production level investments in drip irrigation, greenhouses, advanced storage, hygienic services, and logistics. In Thailand, these effects served to consolidate the many small suppliers

⁶ In Viet Nam, for example, the Domestic Trade Department of Ha Noi views some street vendors as an undesirable influx of the rural and peri-urban poor coming into the city on a daily basis to sell products on the street, causing congestion, unsightliness, and a waste management problem.

to its largest supermarket chain, so that only the more professional operators—usually organized groups or larger farmers—could continue to trade with it directly (van Roekel et al. 2002).

More investment and operating capital are also needed since the greater volume of export and more supermarket channels often means lower margins and delayed payments from buyers. Meanwhile, traditional intermediaries and general wholesalers that provided the framework for moving products from farms to processors and retailers are morphing toward specialized procurers for larger retailers and chains. Consequently, spot and wholesale markets tend to decline in importance and forward contracts expand (Reardon et al. 2003). These contracts often involve require sophisticated harvest and storage operations, centralized distribution systems, and longer shipping distances that create an increasing need for clear standards.

7.3 OVERVIEW OF STANDARDS AND THEIR ROLE IN MARKET ACCESS

Thousands of standards or standards-related agreements exist for the agrifood sector. While many are public with common applications, most of today's agricultural trade standards are privately set by groups or firms and apply primarily to their specific needs. The complex distinctions between process and product characteristics and different types of indirect costs associated with standards can dramatically diminish their benefits and effectively make them barriers to entry (Giovannucci and Ponte 2005). Standards affect not only producers but also value chains, agribusinesses, and consumers, so it is vital to understand who is forming standards, their motivations, their increasing privatization, and the impacts.

7.3.1 Public and Private Standards

Public standards revolving around food safety, consumer protection, and trade facilitation are embodied primarily in government regulations and some international codes and accords. The public standards of individual governments are also important. Often they are the primary portal that products must pass through, and they can be both rigorous and mandatory.

Private standards are those imposed by buyers and usually require higher levels of performance than the baseline public standards. These can apply to such areas as quality, process management, packaging requirements, or

social concerns. Unlike public standards, private standards can be more difficult, particularly because they can be fast-changing. Though sometimes called voluntary, private standards are becoming the basic *de facto* entry requirement for trade with many of the large-scale operators and leading value chains, particularly in higher-value agriculture. Among the best-known private standards are those of the ISO series, HACCP, Fair Trade, organics, and GAP adopted by entities such as the European Retailers Group (EUREP) or the Association of Southeast Asian Nations (ASEAN). Sometimes private sector standards like Certified Organic or HACCP are adopted and codified by government as regulations. In addition to the private standards noted above, individual firms ranging from Cargill and Unilever to Cadbury, Starbucks, and Nestlé are also developing their own internal norms that may differ from the current broader sectoral norms.

7.3.2 Process Standards

Process standards are typically private in character and typically refer to the entire cultivation, packaging, or manufacturing process. These serve as criteria for sourcing decisions, and some pay closer attention to the responsible use of agrochemical inputs, energy, water, wastes, and the impact on communities and the environment. In addition to well-known process standards such as GAP, Good Manufacturing Practices (GMP), HACCP, and ISO, the cause-related standards are becoming increasingly popular. Some better-known examples are (i) Organic, (ii) Fair Trade, (iii) Ethical Trading Initiative, (iv) Rainforest Alliance, (v) SA-8000, and (vi) UTZ Certified. These are sometimes referred to as sustainability standards and are unique in that they can embody somewhat intangible social and environmental characteristics. Although all are managed by or originate from NGOs, these standards have evolved to become much more public in their objectives, transparency, and standard setting. All are nonprofit,⁷ and it can be argued that they fulfill a public good while filling a growing consumer demand (Table 7.2).

7.3.2.1 Organic

Organic products are the fastest-growing sector of the food industry, with global sales growing from \$17.9 billion in 2000 to \$62.9 billion in 2012 (Willer, Lernoud, and Kilcher 2013). High market growth rates are leading to supply shortages in some sectors such as fresh produce, meat, dairy,

⁷ In some countries, organic standards have become public standards by virtue of laws that regulate their application.

and certain processing ingredients. Asia alone has experienced triple-digit growth in organic farmland between 2000 and 2006.

Table 7.2 Comparative Overview of Some Popular Process or Sustainability Standards

Feature	Organic	Fair Trade	Rainforest Alliance
Premium	Premium likely paid especially if certified, but not assured	Premium assured	Modest premium often paid, but not assured
Yield and quality	Short-term impact on yields may be negative; possibly positive impact on some aspects of quality	Only indirect (and possibly positive) impact of yields and quality due to higher income for inputs and labor	Potentially negative yield impact; possibly positive impact on some aspects of quality
Other income impacts	Possibility of selling other organic products from the certified farm; income diversification	Group collaboration facilitates economies of scale	Possibility of selling forest as well as agricultural products
Market access	Access to well-established and reliable market	Access to small but well-established market	Buyers and markets limited but increasing fast with major brands
Extension, credit	Possible extension from supportive NGOs but limited support from public system	Improved access to trade financing and credit and improved financial position of cooperatives	Possible agroforestry extension from supportive NGOs, but limited support from public system
Social impact and organizational capacity	Potential increase in mutual support among farmers to solve farming management problems	Increased organizational capacity of participating farmers; access to training; community projects	Through social norms
Environmental impact	Improved soil fertility as well as resistance to drought and erosion; no synthetic agrochemicals	Limited environmental benefits	Improved biodiversity and agroecological conditions
Risk, planning capabilities	Risk reduction through reduced external inputs; no mono-cropping; soil resilience	Cooperative level planning; guaranteed price reduces risk	Integrated pest management

NGO = nongovernment organization.

Source: Adapted with modifications from Giovannucci and Ponte (2005).

Organic standards are among the most misunderstood. They are sometimes considered to be simply the absence of synthetic inputs; however, this is only one aspect of an organic system. Organic agriculture relies on scientific and traditional knowledge to work with biological and mechanical methods to manage ecological systems. It works to optimize quality and sustainability while reducing external inputs and synthetic materials. Social issues such

as labor rights and conditions and general environmental principles are also part of organic principles but specific guidelines on aspects such as biodiversity are not necessarily part of the certification processes. Organic certification can also apply to processed food; most artificial preservatives or additives are avoided. For the purposes of most trade, organic products are third-party certified and include both internal controls and traceability. However, for local applications, different credence mechanisms are often utilized that do not depend on formal certification processes. These are often lower in cost and can be equally effective (Giovannucci 2005).

7.3.2.2 Eco-Friendly or Safe Foods

A broad range of standards exists that are focused primarily on ecological systems and the assurance that production of agricultural products avoids toxic chemicals or other forms of contamination. Rainforest Alliance standards are among the best known of this category; the agriproducts are sources in dozens of countries for sale primarily to the US, Europe, and Japan. Some nations have also developed standards. Japan has a government production standard that references ecologically friendly measures, as well as food safety and requires certification by an accredited body. In the PRC, “green foods” are government-certified products and are safe from chemical contamination and utilizes environmentally friendly production processes; it is already recognized by PRC’s trading partners in Japan and Europe. In 2003, green food exports topped \$1.5 billion. In India, less formal approaches, commonly called either “Jaivic Krishi” or “Vedic Krishi” include several traditional holistic farming systems based on ancient techniques. These are neither government regulated nor formally certified, but are followed in many of the country’s regions.

7.3.2.3 Fair Trade

Fair Trade is an alternative to the often asymmetrical buyer/producer negotiations featured in conventional trade and aims to improve the livelihoods and well-being of small producers by assuring a fair price agreement, continuity in trading relationships, and the strengthening of small-producer organizations. Fair Trade products are typically sold in more developed markets via an NGO-operated certification system. Fairtrade Labeling Organizations International (FLO) is the global coordinating body for certified products. There are around 827 FLO certified producer organizations in 58 producing countries, representing over 1.2 million farmers and workers. In 2009, FLO certified sales reached €3.4 billion worldwide (FLO 2011).

7.3.2.4 *Codex*

Codex Alimentarius Commission is an intergovernmental body facilitated by the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization which aims to protect consumer health and facilitate international trade in food. For decades, its guidelines have been internationally recognized benchmarks for food products and form a basis for many public standards and the development of many national regulations. It has evaluated hundreds of food additives and common contaminants and set maximum residue limits for approximately 2,500 combinations of commodities and pesticides. However, Codex is a large, consensus-oriented organism and is therefore relatively slow to adapt to the needs of day-to-day trade and recommend timely changes.

7.3.2.5 *International Organization for Standardization*

The International Organization for Standardization (ISO) is a network of national standards institutes from 164 countries and is organized as an NGO. It aims to facilitate international exchange of goods and services, and sets a number of the most popular trade standards and fosters standardization activities. Its standards are voluntary and typically codify sectoral best practices. An ISO-certified process signals conscientious management.

ISO has published over 15,000 standards and guidelines relevant to producers and agri-food enterprises. The 9000 series, the most popular, promotes good management practices to ensure the consistent quality and delivery of goods and services. The 14000 series promotes sound environmental management in order to minimize negative effect caused by various productive activities including agricultural processing. ISO 22000 is designed for generic food safety management systems,⁸ and ISO 26000 covers guidance on social responsibility. ISO's importance extends to verification mechanisms, in that many governments and private firms insist that certification bodies comply with a standard (ISO 65) that is an international equivalent and recognized for other rulings such as European Norm EN 45011.⁹

⁸ ISO 22000 is an auditable standard and aligned with Codex's HACCP but goes farther with requirements for food safety management systems and specific areas such as strengthening prerequisite programs and transforming the recommendations into requirements.

⁹ Similarly, ISO 61 is the recognized guideline for accreditation bodies and is often the benchmark for national rulings on this (e.g., The European EN 45010). ISO 62 covers quality system certifiers.

7.3.2.6 *Hazard Analysis at Critical Control Points*

The Hazard Analysis at Critical Control Points (HACCP) is a systematic analysis for potential food safety risks within, for example, a postharvest or processing operation. The analysis typically identifies appropriate control and monitoring systems to minimize such risks. It assures that such a management approach has been established but not whether it is used or how effectively. It is most often used with higher-risk foods, such as poultry, livestock, and fish products. Typically, HACCP reduces food contamination risk in two ways (i) anticipates potential problems before they happen; and (ii) increases chances of resolving problem during process, rather than at the end of process, or once the product moves into the supply chain or market. Consequently, HACCP can also yield cost savings in terms of reduced waste, reprocessing, or recalls.

7.3.2.7 *Good Agricultural Practice and Good Manufacturing Practice*

The more recent ASEAN Good Agricultural Practice (GAP) standard is adapted to conditions in Asia and the Pacific and has many similarities to EUREP-GAP (known as Global-GAP as of September 2007). These standards are widely used by many companies, especially by firms that export to Europe. They are based on GAPs that promote basic food safety principles to minimize biological, chemical, and physical hazards associated with crops from seed through harvest storage.¹⁰ In addition to GAPs, the Good Manufacturing Practices (GMPs) begin from the harvest and storage stage and serve to guide the people working in contact with food, its packaging materials, and work environs to conform to basic sanitation and hygiene practices to protect against food contamination from both direct or indirect sources. These standards typically also improve worker safety.

7.3.3 *World Trade Organization Access and the Role of Sanitary and Phytosanitary and Technical Barriers to Trade Agreements*

The public or governmental application of sanitary and phytosanitary (SPS) or technical measures can act as standards and have a growing impact on the nature and direction of international trade controls. Although part of the WTO for some time, the SPS and Technical Barriers to Trade (TBT)

¹⁰ They specifically address the following topics: site selection; adjacent land use; water; fertilizers; herbicides/pesticides; hygiene; field, facility, and worker hygiene; product cooling; and transportation.

agreements are increasingly important ways to manage trade in light of the diminution of tariffs, quotas, and other formal measures (UNCTAD 2006).

SPS measures are intended to ensure human food safety and protect agricultural plant and animal populations and ecosystems. The SPS agreement recognizes the right of countries to maintain national standards that are stricter than international levels, provided they are justified by scientific evidence and applied consistently.

The TBT agreement aims to stop WTO members from using arbitrary technical regulations, standards, or testing and certification procedures to protect domestic producers. It applies to all aspects of food standards not covered by the SPS agreement, including labeling requirements, nutrition claims, and quality and packaging regulations, which are generally not considered as either sanitary or phytosanitary measures. TBT prevents members from distinguishing between goods on the basis of either production or processing methods, but specifies conditions when members may restrict trade using technical regulations or standards. The WTO recognizes three organizations as sources of internationally agreed-upon benchmark agrifood standards that can affect SPS and TBT: the Codex Alimentarius, the Office International des Epizooties¹¹ (known as OIE) for animal health, and the International Plant Protection Convention¹² (IPPC) for plant health.

7.3.4 Harmonizing Standards

Efforts have been made to develop more coherent meta-standards, particularly for food safety, albeit not without concern of noncompliance from poorer nations. The International Committee of Food Retail Chains (CIES) Global Food Safety Initiative is one harmonization effort to provide a single set of rules for standards. The International Social and Environmental Accreditation and Labeling (ISEAL) organization also strives to achieve harmonization among some of the most important eco-social standards bodies including International Federation of Organic Agriculture Movements (IFOAM), Rainforest Alliance, FLO, UTZ Certified, and the Forest Stewardship Council. Their efforts can provide useful

¹¹ The OIE is an 83-year-old intergovernmental organization that analyzes and disseminates veterinary information to provide expertise and transparency in control of global animal disease (includes aquatic).

¹² The International Plant Protection Convention (IPPC) is a standards treaty that aggregates 19 approved international standards, establishing measures to prevent the introduction and spread of plant pathogens and pests. Its secretariat is within FAO, but it works through national and regional plant protection organizations such as the Asia and Pacific Plant Protection Commission or the European and Mediterranean Plant Protection Organization to help countries meet their IPPC obligations.

stepping stones for countries to collectively adopt standards guidelines and training frameworks that have broad-scale relevance and can reduce the individual cost of compliance.

7.4 THE CURRENT CAPACITY TO MEET EMERGING MARKET REQUIREMENTS

7.4.1 The Challenge

While a hurdle for most developing-country farmers to overcome, standards may provide unique market opportunities. Compliance means farmers can reduce the risk of rejection in the marketplace and provide access to new, more profitable market segments. Since standards set some producers apart, the differentiation can serve as a competitive tool. However, noncompliance with at least the basic standards, have potentially serious consequences for economic growth, poverty alleviation, and even food security (Vander, van der Wal, and Oldenziel 2006; Moustier et al. 2005; Reardon et al. 2003).

Most producers face common barriers when considering standards:

- (i) **Selecting** which among the standards requires market intelligence, contact with buyers, experience in assessing the relative demands, costs, and benefits of each—where data are virtually nonexistent.
- (ii) Few **institutions** exist to facilitate the adoption of standards as an ongoing learning process.
- (iii) **Capital** to invest in new processes, equipment, and infrastructure is difficult to access.
- (iv) Transaction costs for **certifying** products can be high and a barrier to entry.
- (v) **Risky learning** is often done at an international level since local market demand is modest.

Many processors, exporters, and retailers—especially for higher-value products—favor producers that can meet their demands for standards, large volumes, and year-round consistency. They sometimes create their own collection or purchasing systems that bypass local market networks thus reducing access. Typically this forces small and medium-sized suppliers to either consolidate into organizations or larger firms, or to compete for the lower-value channels that remain. Three quick-sketch case studies point to the positive and negative experiences of different approaches (Boxes 7.2, 7.3, and 7.4).

Box 7.2 Thailand Case Study

A value chain analysis was carried out on Tops Supermarket group, a dominant food retailer in Thailand, revealed (i) variability of prices due to high losses from inadequate storage and refrigerated transport; (ii) slow order response time due to poor production methods, planning, and information flow; (iii) inability to meet product specifications due to inadequate quality controls; (iv) coordination difficulties among small suppliers; and (v) lack of trust and cooperation among participants in the value chain.

Specific requirements for perishables were unmet by existing supply structure. Certification under the Ministry of Agriculture's new food safety program eliminated 190 of the 250 of its suppliers (Boselie 2002). Only a few of smallholders could continue supplying, and only by organizing as a group of second- or third-tier suppliers and subcontracting to the larger preferred suppliers that had the capacity and investments necessary to directly contract with World Fresh Distribution Center.

As this case shows, competitive requirements served to eliminate smaller-scale participants. While public-private cooperation can overcome problems for some participants, the lack of appropriate institutional structure and the explicit intent to integrate a broader group of suppliers effectively excluded many.

Source: Van Roekel, J., R. Kopicki, C. Broekmans, and D. Boselie 2002.

Box 7.3 People's Republic of China Case Study

Under different organizational models, small producers can meet very high quality standards and even achieve international certification as shown in Feicheng, Shandong Province, the People's Republic of China.

Local government committees provided the institutional framework to organize large-scale value chains that feed processing companies in the region. One of the companies involved, Tai'an Asia Food Co., a Sino-Japanese joint venture, receives produce from about 10,600 farmers. Farmers typically earn several hundred US dollars annually from their small plots averaging less than 0.1 hectares. Much of Feichieng's reclaimed land was rendered toxic from excessive chemical use.

Feicheng specializes in internationally certified high-value organic produce for overseas markets, producing 20 kinds of horticulture crops with annual volume of roughly 130,000 tons. With the government acting as a catalyst, the processors, local input, transport, training enterprises, and farm communities have developed relations reminiscent of Porter's cluster model.^a The interface between farmers and the large enterprises is often mediated by the local government, which provides a tailored framework, which involves training, certification, extension services, and the facilitating of input distribution where necessary, to support farmers' participation.

continued on next page

Box 7.3 *continued*

Critical to its success is access to sufficient and consistent training, especially during the conversion phase when many producers were unfamiliar with the new requirements. A steadfast, reliable institutional structure, e.g., local government, facilitated the producers' willingness to adopt new methods and substantially reduced their risk. Equally important was the presence of a dependable value chain that ensured access to lucrative markets.

^a Michael Porter's cluster theory is useful for understanding the nature of complementary and sometimes competitive enterprises grouping in a region for mutual benefit. See, for example, Porter (1980).

Source: Original case study conducted for Giovannucci (2005).

Box 7.4 Indonesia Case Study

For most Indonesian consumers, fresh fruit and vegetables (FFV) are taking on an increasing share of their total food expenses, especially true in urban areas where supermarket channels are expanding their share of the business. However, much of the business does not involve Indonesian producers.

Nearly all retailers prefer to purchase imported FFV products rather than deal with Indonesian farmers due to inadequate value chains, missing or low-quality infrastructure, and poor standards. A striking 60% of the FFV sold by supermarkets are imported (approximately 80% of fruit and 20% of vegetables), considerably higher than the figures in other comparable developing countries. Larger retailers source directly from large-scale importers, while specialized wholesalers are making inroads by focusing on the needs of modern food industry channels, such as fast-food chains and restaurants, institutional users, and supermarkets.

In West Java, the most prolific FFV production area, farmers typically lack capital and self-organization to produce according to the requirements of supermarkets. Some specialized or dedicated wholesalers are increasingly working with small farmers but not more than 15% in any area. The notable lack of support services and institutional and physical infrastructure leads wholesalers and farmers to perceive the new FFV markets as only for the most capitalized and capable. Indonesian FFV farmers are essentially uncompetitive in their domestic consumer markets.

Source: Natawidjaja, R., S. T. I. Noor, T. Perdana, E. Rasmikayati, S. Bachri, T. Reardon, and R. Hernández. 2006.

7.4.2 Inadequate Standards and Forsaken Value

Lu (2005) estimates that in 2004 alone, the PRC lost approximately \$8 billion from reduced exports due to its failure to meet standards in numerous agricultural subsectors including grains, apiculture products, livestock, fungi, and fruits and vegetables. The recent discovery in Europe of illegal, genetically modified rice from the PRC prompted the European Commission to place far-reaching import restrictions that would affect numerous rice farmers. According to the EUobserver, the European Union (EU) verified all consignments of rice products from the PRC in 2011 (Phillips 2011). It is not just the inability to meet food safety standards that diminishes potential income. Coffee producers in Cambodia and the Lao People's Democratic Republic, lacking technology and processing infrastructure, are limited to domestic markets and some proximate cross-border trade (International Coffee Organization [ICO] statistics 2012).

7.4.3 Implications for Producers

Currently, increased standards primarily impact those dealing with larger buyers or with the market for higher-value products, but will eventually become part of the equation for more buyers and for a broader range of products, even in secondary markets. For producers to be competitive and have market access, they have to address eight development areas:

- (i) *Institutional structures*: for delivery of localized production training, and farm and organizational management.
- (ii) *Market intelligence*: understanding what and when to produce, and according to what standards in order to meet buyer specifications.
- (iii) *Quality*: better inputs, such as high-quality seed and appropriate varieties, for market-oriented production, and capital investment for harvest and postharvest requirements.
- (iv) *Quantity*: group organization for smaller producers to pool produce.
- (v) *Consistent supply*: appropriate late- and early-season varieties, as well as investment in greenhouse production.
- (vi) *Trade transactions*: sound contract law with simple dispute resolution mechanisms.
- (vii) *Certification*: low-cost certification and efficient product testing services.
- (viii) *Trade financing*: contract farming and other internal value chain financing.

Enforcing standards without adequate incentives is difficult. IFAD research evaluating organics in Asia (Giovannucci 2005) found that some

aspects of standards may be bypassed where producers gain little benefit from compliance, especially where compliance is not easily checked at the farm gate. In the case of arabica coffee, Varangis, Siegel, Giovannucci, and Lewin (2003) found that where farmer production was blended together by traders, thereby losing individual product identification, there was little or no reward for compliance and only minimal penalty for noncompliance. Accordingly, the overall quality suffered as few farmers complied with the established standards.

7.5 COSTS AND BENEFITS OF AGRICULTURAL TRADE STANDARDS AND THE ROLE OF CONTRACTS

Clearly, standards are a risk management tool, particularly for buyers that want to ensure the quality and safety of their supply. The demand for standards is being pushed increasingly upstream in value chains toward producers, as a result both of government initiatives and private sector demands. Compliance improves market access, and, in some cases, producers may also enjoy other direct benefits and bear associated costs.

Benefits

- (i) Improved operational and managerial efficiency
- (ii) Greater participation in global supply chain and high-value products
- (iii) Environmental benefits of erosion reduction and soil improvement
- (iv) Health benefits
- (v) Food security, including that of the rural poor (small farmers)
- (vi) Economic benefit, price premiums.

Costs

- (i) Transition difficulties potentially affecting yields
- (ii) Investments in time and learning
- (iii) Financial investment for infrastructure and technology
- (iv) Higher operating costs for more complex processes.

7.5.1 Direct and Indirect Benefits

In some cases, implementing standards can improve operational and managerial efficiency. Giovannucci (2005) found that when small-scale traditional producers in Asia shifted to sustainability-oriented standards, such as organics, they incurred additional costs but generally enjoyed long-term yield improvements and profitability, due primarily to better farm management practices and price premiums. The results among

intensive producers were mixed, with some resulting in net economic benefits (Giovannucci 2005).

By fostering agricultural methods that improve not only the soil's natural fertility, but also its ability to withstand natural calamities, such as drought (Altieri 1999) and more efficient use of nutrients (Mäder et al. 2002), the likelihood of food shortages can be reduced. Setboonsarng (2006) notes several studies showing farmers that meet organic standards lower production costs, reduce risks of crop failure, and improve ecological management of local resources which contributes to local food security. Bartram and Perkins (2003) reviewed 33 published studies and concluded that substantial biodiversity advantages existed when organic standards were applied in addition to economic benefits. Increasingly, sustainability concerns are incorporated in private standards, such as Global-GAP and ISO. In most cases, meeting standards, such as organics, means producers are able to meet most of the environmental requirements.

Besides the clear economic value of market access, the evidence for direct economic returns resulting from the application of standards is less clear. Research on the actual costs and benefits incurred in the adoption of standards is limited, although the Committee on Sustainability Assessment (COSA) has made attempts to measure costs and benefits of the major sustainability standards. It is often hard to tell the extent to which a price premium is paid for achieving a standard or for meeting a quality level, except for more complex sustainability- and ethical-trade related standards, such as organics and Fair Trade. Conversely, when products fail to meet basic standards, they are likely to face a price penalty.

7.5.2 Direct and Indirect Costs

Several types of costs typically are involved in the adoption of standards. First, a learning curve can require prolonged time investment, and costly institutional support from a producer organization, community, government agent, or NGO. Confusion about types of standards and their specific requirements is an intangible cost. Second, equipment or infrastructure investment may be required to meet standards. Third, it may include cost of independent certification for compliance and traceability.

Traceability through the chain is increasingly relevant and challenging particularly in critical situations, for example, positive residue tests, false or fraudulent declarations, or discrepancies in quantities traded. While direct certification costs are relatively simple to measure, other

typical costs may be variable, depending on requirements of a specific standard and the producer's or processor's current ability to meet that standard. In some cases, the process of compliance can take years before costs are recouped. Without reliable market access, the often higher operating costs of a new standard can be onerous. However, standards are not necessarily exclusionary for small producers. More localized and labor-intensive aspects of organic and Fair Trade standards favor small producers and laborers.

Standards can have unintended consequences—and considerable costs—for producers as well as entire agricultural subsectors. For example, the lack of credible public food safety standards in Bangladesh decimated its poultry industry for about a year after bird flu was found in Southeast Asia in 2004, even though none was reported in Bangladesh. In Southeast Asian banana plantations, Dardaine (2003) notes that buyers insist that workers wear gloves and masks while spraying at the packing station where temperatures can reach 40°C, yet will not increase the price paid for a box of bananas to cover such costs.

Standards can provide opportunities for increasing sustainable production and improving quality and overall competitiveness. However, many smallholders face reduced extension services, inadequate information, and outdated capacities. The application of private grades and standards could inadvertently lead to the consolidation of producers, excluding smallholders from the value chain. A welcome development is the increasing support of countries of private-sector-based tools, such as contract farming to better deal with this challenge.

7.5.3 The Role of Contracts in Agricultural Trade Standards

Contract farming is a way to enable small and medium-sized producers to access the benefits of standards. Using contractual arrangements, agroindustry can assist some farm families to shift from traditional agriculture to production of higher-value products (Patrick 2003). This may potentially increase incomes of contracting smallholders, reduce risks, and have multiplier effects in the rural economy (see Chapters 1 and 2 of this volume). Generally, the buyer of produce selects standards and transmits this condition up the value chain. Contracting firms provide the technical, financial, and physical capital required for compliance often lacking in small producers. Since small producers rarely visit the terminal markets for their products, they may not be fully aware of specific requirements. For example, a processing and exporting firm in southern Africa was able to enter a European-dominated market by providing extension services

local farmers to help them achieve the desired color range for peppers that were to be exported as paprika (Purcell and van Gent 2005; Giovannucci et al. 2001).

Contract farming can also improve market access through aggregation of supply and provision of the necessary packaging, transportation, and transaction requirements to enable sales and higher-value markets. For example, a large commercial horticultural firm in Zambia helps smallholder farmers sell EUREP-GAP certified vegetables to Europe by providing them access to the firm's own packing plant and airfreight quotas (Purcell and van Gent 2005).

A certain balance of power between participants in the value-chain is necessary to facilitate sound relationships, and unless farms are large or well organized, this requires the presence of viable institutional structures. Poulton et al. (2004) noted that contracts were more successful in areas where there was neither a monopsony nor perfect competition among buyers (MMWBP 2005). Likewise, contract farming of undifferentiated product (e.g., ordinary rice) was not as successful as that of specialty product (e.g., organic aromatic rice) in Viet Nam, as side-selling is more difficult for specialty products (MMWBP 2007).

In Viet Nam, the government's efforts to increase the use of contracts to improve procurement and efficiency in the rural economy have largely been unsuccessful. Nguyen et al. (2004) and Tran et al. (2004) suggest three reasons for failure (i) farmers renege on contracts when offered higher prices from traders, (ii) contractors tighten quality standards to limit procurement when there is an oversupply, and (iii) parties often lack knowledge of contractual obligations (MMWBP 2005). Noteworthy about successful contracts are (i) contractual arrangement is not "one size fits all", (ii) institutions should address limited organization of producers and the imbalance in market relationships, and (iii) parties need to be educated on the nature of contractual obligations and to develop enforcement mechanisms (formal or informal). All these point to greater public sector roles and tightening of the value chain through improved private-sector organization, in order for the poor to benefit from their participation in contracting relationships (MMWBP 2005).

7.6 CONCLUSIONS AND RECOMMENDATIONS

Standards are increasingly critical for global trade competitiveness. However, even in domestic markets in less developed countries, compliance with standards increasingly represent the rules of the game, particularly

for higher-value and perishable products including fruit, vegetables, seafood, dairy, and meat products. As standards are rapidly evolving, this poses substantial challenges especially for smaller producers but can also present a host of opportunities. The recent ubiquity of standards and new value-chain models present a unique opportunity to learn and develop appropriate interventions that spur the competitiveness of inputs, production, processing, and marketing. For developing countries, these standards provide competitive options with higher-value products, especially sustainability standards such as organics whose process management and traceability can aid market entry and whose application methods are well suited to small-farm conditions.

As the public sectors in most developing countries often lack know-how in standard compliance, public-private partnerships in institutional arrangements, such as contract farming and semi-private extension services, are vital to ensure participation of smallholders or rural enterprises. Given the unique nature of standards, an innovative response will be necessary in order for government to be effective. Two issues are predominant (i) information and capacity building to help producers, firms, and traders compete; and (ii) institutional structures to enable the majority of farmers and SMEs to invest and participate.

7.6.1 Policy Focus

Van Gelder et al. (2006) note that “Policies on food safety often lead to standards that cannot be met by southern countries” and that a program to build capacity is necessary to meet standards. The World Bank, formulating its rural strategy in 2003, acknowledged how market trends require a new focus on knowledge, value chains, and sustainability that align with the inevitable standards needed for higher-value crops, sustainable production systems, and chains. This change in emphasis reflects a similar policy focus in many of its progressive client countries.

As government policies can influence distributional outcomes affecting competitiveness in the long run, they should be designed so as not to create unnecessary disincentives for parties involved in the chain. Taxation policies should be coordinated between producers and their contractors with no hidden charges and/or burden on either party. As building capacity on standard compliance is a necessity, initial training should be basic and relevant across sectors and markets. For example, integrating GAP practices into basic production methods introduces production sustainability and also serves as the baseline requirement for many other

field standards. Subsequent interventions can progress toward more sophisticated standards, such as organics, that can have broader local environmental impacts and international market relevance.

7.6.2 Public and Private Roles

Public and private roles around the issue of standards are intimately intertwined and complementary. On the whole, governments in many developing countries appear unprepared to handle new standards. This is important since even the slow-to-change public standards, such as the maximum residue levels, are progressively more demanding. Concern exists on public standards being used as non-tariff trade barriers, and the high compliance costs may erode comparative production advantages in developing countries.

As development of private standards at the firm-level proliferates, these standards can cripple smallholders who often lack internal control systems, technical capacity, and investment capital.¹³ Therefore, if they do not participate in proactive value chains or have a measure of institutional support, they may essentially end up producing less-tradable goods.

Accordingly, dealing with standards requires new, more agile institutional structures which can equitably link international capacity to local needs. A better collaboration with value chains via practical structures, such as contract farming, will help ensure competitiveness and inclusion of SMEs and smaller farmers. Consequently, it is imperative for government to take the lead in creating an enabling environment to meet three objectives:

- (i) **knowledge management infrastructure** to both distill information and provide access to it;
- (ii) **business development strategies** that integrate with the private sector to ensure standards relevance; and
- (iii) **institutional structures** oriented to producers but also encompassing the entire chain to guarantee both equity and long-term competitiveness.

Knowledge management. Producers, SMEs, and value chains should have access to local knowledge platforms to aid awareness and understanding of the drivers, threats, and opportunities implicit in relevant and forthcoming standards and to better understand emerging market trends in different areas, differences between standards, and implications of adopting

¹³ Trade associations also create standards in their role as proxies for private firms.

particular ones.¹⁴ Basic knowledge on standards should be conveyed in a variety of teaching forms, which range from farmer field schools to vocational training schools in order to enhance the skills of farmers and extension agents. Producers and traders also need knowledge management systems that can provide more dynamic market intelligence. They should have access to existing private information sources and ongoing public initiatives, such as those developed by the International Food Policy Research Institute (IFPRI) and by the International Center for Tropical Agriculture (CIAT by its Spanish acronym).

Business strategies. Public–private partnership can help smallholder producers to more effectively participate in value chains. Trade participation of most producers and SMEs will occur through value chains. Without accessible knowledge systems and supporting institutions, smaller and weaker chain members are more likely to be eliminated than strengthened. The government should partner with the private sector to develop strategic medium- and long-term public responses that effectively support competitive value chains.

Institutional structures. National and local institutional structures are vital in creating immediate local capacity and establish the institutional trajectories necessary to foster long-term agricultural competitiveness, as well as include rural producers and SMEs. These institutional structures and supporting policies include NGOs, educational centers, producer organizations, trade associations, and local government agencies such as extension services. They also are market information systems, certification systems, regulatory mechanisms, and enforcement mechanisms to monitor and ensure compliance.

Institutions should foster transparency and interrelatedness in the systems, and provide consistency at the local level as well as market-oriented linkages to international technology and information. Without these frameworks, smaller producers and SMEs will find it difficult to adapt and to equitably participate in value chains and markets.

¹⁴ For example, the work of the Sustainable Commodity Initiative's COSA provides institutions with a detailed grasp of producers' full costs and benefits involved in adopting diverse sustainability standards and initiatives.

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8. Food Safety and Information and Communication Technology Traceability Systems: Lessons from Japan for Developing Countries¹

Jun Sakai, Sununtar Setboonsarng, and Lucia Vancura



8.1 INTRODUCTION

In recent years, the global food industry has been rocked with scandals from microbiological contamination (i.e., *salmonella* and *E. coli*) to melamine-tainted baby formula. Numerous cases of labeling fraud and fears of deliberate malicious attacks on the food supply make headlines around the world. These cases have increased public wariness regarding food safety in the increasingly complex and globalized food production and trading system. International organizations, governments, and private companies are all facing the necessity of responding to these fears and minimizing further risk to the supply of safe food.

Establishing a food traceability system² is one strategy governments and companies use to win the confidence of consumers and to comply with the documentation requirements under multinational and bilateral trade agreements. Good traceability systems provide reliable product documentation, which can support compliance with international safety control system standards. The food industry has already developed food safety systems, including introduction of Hazard Analysis and Critical Control Point (HACCP),³ and comply with global standards such as ISO certifications and World Trade Organization (WTO) standards like the sanitary and phytosanitary measures.

¹ First published as J. Sakai, S. Setboonsarng, and L. Vancura. 2009. "Food Safety and ICT Traceability Systems: Lessons from Japan for Developing Countries." ADBI Working Paper No. 139. Tokyo: Asian Development Bank Institute. Available: <http://www.adbi.org/files/2009.05.28.wp139.ict.food.traceability.system.pdf>

² In this chapter, we use the International Organization for Standardization (ISO) 22005:2007 definition of traceability as, "The ability to follow the movement of a feed or food through specified stage(s) of production, processing and distribution." This definition describes the most basic achievement of a traceability system: following the movement of a product as it moves through the food chain "from farmer to fork." It should be noted that (i) this ISO definition is adapted from *Codex Alimentarius* (CAC/GL 60-2006); and (ii) "movement" can relate to the origin of materials, their processing history, or the distribution of the feed or food.

³ HACCP is a system of quality control management that identifies potential hazards in the food production process and puts into place strict actions that must be taken to prevent the hazards from occurring. Each company's HACCP system is independent and yet must be able to provide data to the next company in the food chain. HACCP is being adopted worldwide under the recommendation of the *Codex Alimentarius* Committee of the United Nations. It has already been mandated in many countries.

8.2 TRACEABILITY REQUIREMENTS AND DEVELOPING COUNTRIES

Most food exporters from developing countries would be able to comply with the government-mandated minimum legal documentation requirements on traceability. It is the stricter private requirements of the buyers⁴ that are a burden to exporters. These private requirements have developed in response to consumer demands and buyers' assessment of financial risk, and to fulfill the conditions of free trade agreements (FTAs) and the WTO. For example, food for export must conform to various standards such as Good Agricultural Practices (GAP), Good Manufacturing Practices (GMP), and HACCP. In cases where value-added food products were produced using raw materials from many sources, the documentation and traceability required by the buyers to ensure food safety and to certify sufficient processing threshold (SPT) under relevant FTA standards can be overwhelming to exporters.

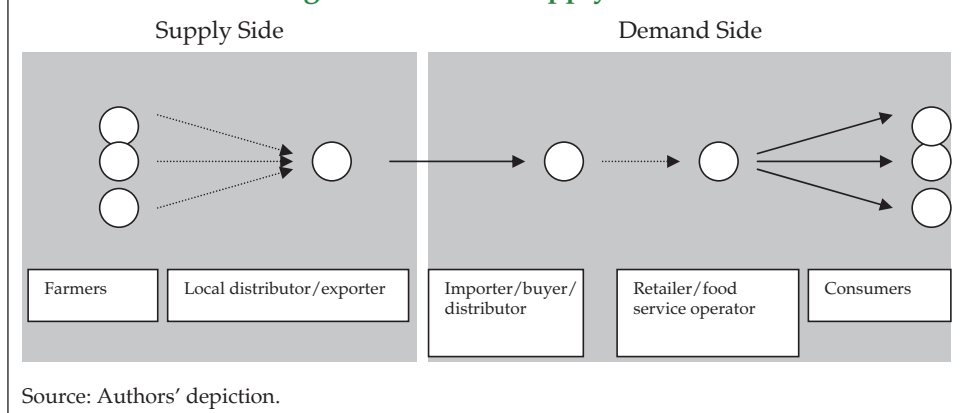
Developing countries aiming to export to the lucrative markets of industrialized countries must have adequate information about buyers' requirements, as well as a solid system for collecting and presenting the necessary information. However, because the food supply chains in developing countries are typically fragmented—relying on many smallholder farmers—and are not necessarily organized into supportive producer associations that can provide the training needed to create traceability documentation, many of these smallholders will be excluded.

Figure 8.1 is a simplified depiction of how goods flow in domestic and international food supply chains. Even in the simplest export chains, food products change hands multiple times. As a result, fully traceable documentation of food product movement quickly becomes very complicated. In addition, each buyer may also have their own requirements for suppliers,⁵ including slightly different documentation that results in duplicated or time-consuming efforts.

These international trade requirements are already forcing producers who want access to international markets to conform to certifiable standards. However, meeting these standards still does not ensure that a full traceability system—monitoring all movements of the food product—is in

⁴ "Buyer" refers to a food business operator who buys food products from a supplier. A processor, packer, wholesaler, retailer, or food service operator may act as a customer.

⁵ "Supplier" refers to a food business operator who supplies food products to customers. A farmer (or group of farmers), importer, manufacturer, packer, or wholesaler may act as a supplier.

Figure 8.1 Food Supply Chain

place. Standards may require records of certain procedures and processes, but they do not necessarily provide a full and reliable accounting of food movement in the supply chain.

Traceability is becoming an increasingly common element in many more complex supply chain management systems, such as those that monitor regulatory compliance, quality control, environmental impact, or food safety. In addition to traceability of movement, these more complex systems may include detailed information on production inputs. These inputs could include vaccinations, agrochemical use, hygienic conditions of the processing environment, or any other information essential for maintaining the trust of buyers and compliance with relevant regulations.

8.3 THE EVOLUTION OF TRACEABILITY SYSTEMS

Traceability systems emerged in the mid-1930s in Europe as a way to prove authentic origin of high-value food, such as French champagne. In recent years, such systems have also been called for by increased consumer demand and by public sector action to improve food safety assurance. Capitalizing on the attention to this issue, food marketing strategies have arisen to use traceability systems to support branding. Such strategies can be seen in recent labeling trends, such as organic, Fair Trade, or low-carbon production. As suppliers, buyers, consumers, and governments all respond to the incentives to create food traceability systems, global standards and new technologies are being developed to support efficient and consistent traceability.

8.3.1 Role of Governmental Regulations

To support international agreements on food trade, such as WTO requirements, national governments are introducing regulations that primarily address the following issues:

- Record keeping and documentation requirements related to food products
- Labeling, including origin labeling
- Requirements related to product removal, recall, and notification.

To fulfill these governmental regulations, it is generally not necessary for companies to implement a thorough traceability system. However, some governmental regulations are stricter than WTO minimum requirements. The European Union (EU) has been the first to put minimum traceability standards into law, as it has under EU Regulation EC 178/2002 Article 18. In addition, for some products such as seafood, EU regulations require them to come from authorized processors that are in compliance with a variety of EU food safety and traceability regulations, as well as international food safety systems such as HACCP. The strict requirements are forcing companies to choose between meeting the strict standards of top export markets and changing to less lucrative foreign or domestic markets.

8.3.2 Role of Buyers' Requirements

Despite the strict requirements of some governments, the strictest traceability standards are still those imposed by buyers, i.e., trading companies, wholesalers, and retailers. Buyers set their requirements based on what they perceive as demanded by the market, as well as by law. The buyers will demand information or documentation they feel is necessary to minimize the risk of a problem within the food chain. In highly competitive markets, a single food safety incident can ruin the brand name and even the business, and therefore buyers in extremely competitive markets, such as Japan, tend to have extremely strict requirements for their suppliers.

Once buyers have outlined their traceability documentation requirements to the suppliers, there are generally two methods used by buyers to confirm that suppliers have fulfilled the requirements. In the first method, the requirements are privately agreed upon between the individual buyer and seller. In this case, staff from the buyer's company or an auditor hired by the buyer will confirm that the documentation fulfills the agreed upon requirements. In the second method, the buyer requires the supplier to become certified as compliant with an open standard. In this case, suppliers

are certified by and then subject to audit by the appropriate certification body. Open standards with traceability requirements include the British Retail Consortium Global Standard, International Food Standard, Safe Quality Food 2000 Code, Global-GAP General Regulations, and ISO 22000:2005.

In general, the traceability requirements of these certifications are (i) product identification; (ii) record keeping for one-step-back, one-step-forward, and internal traceability; and (iii) periodic internal checks of the supplier's business to ensure traceability between the raw material received by the supplier and the finished product. It is important to note that these standards do not specify the exact data that must be collected or the method by which the data are supplied to buyers.

8.3.3 Certification Systems

In addition to the open standards, there are many other types of certification systems such as organic, Fair Trade, or carbon certification, which are based on ethical or sustainability concerns and require documentation of inputs or production methods. In general, there are three types of certification: first-party, second-party, and third-party certification (Setboonsarng 2008). Each of these types of certification uses different auditing systems.

First-party certification is self-claimed or community-based certification. An individual farmer or group of farmers in a local community will sell a product that they guarantee is, for example, a pesticide-free tomato or free-range poultry. This method relies on consumers having a trusting and usually face-to-face relationship with the farmers or sellers.

Second-party certification is a system in which an intermediary that has a close relationship with the farmers provides consumers with information about the product. Some supermarkets use this system for the organic produce they sell. Second-party certification can be considered to be similar to product branding; the effectiveness of this type of certification relies mainly on the reputation of the trading agent.

Third-party certification entails an impartial third party auditing the production process or product movement to ensure that conditions set out under the standards have been adhered to. With a third-party reviewer, global and international standards can be introduced that will be consistent across borders and throughout complex trading relationships. This type of certification system, however, is generally far more costly than first- or second-party systems.

8.3.4 Uses of Information and Communication Technology

To lower information costs associated with traceability systems, the use of information and communication technology (ICT) is being explored. The key processes that ICT can support are (i) identification of food products, (ii) data input, (iii) data transfer, and (iv) verification.

Identification of food products requires product labeling to be easily identified at each stage in the production process and supply chain. *Data input* requires documentation on processes the products undergo as they move through the supply chain, including locations, dates, times, and temperatures. *Data transfer* requires information sharing among the various food business operators, as well as consumers, auditors, and government inspectors. Finally, *verification* should be done to affirm that claims of products are true, by comparing raw material input volume with processed product output volume or by scientific testing such as DNA or chemical analysis.

Table 8.1 Traditional vs. ICT Methods of Traceability Documentation

Operations Necessary for Implementation of Traceability System	Technologies Already Used	ICT Technologies Applied Recently
Identification of food	Stamping with ink	<ul style="list-style-type: none"> • Printing technology (inkjet printing, affixing printed labels)
Data input	Handwritten or manual input	<ul style="list-style-type: none"> • Auto identification technology such as bar codes, two-dimensional bar codes (quick response [QR] codes), or the experimental\radio frequency identification (RFID) • Global positioning system (GPS) • Hand-held sensors to scan and record data
Data transfer	Fax	<ul style="list-style-type: none"> • Disclosing information to customers through websites • Exchanging data electronically among food business operators
Verification	Onsite visual inspection	<ul style="list-style-type: none"> • Software that automatically calculates and compares total volumes received and released • Examination technology such as DNA examination

ICT = information and communication technology.
Source: Authors' own compilation.

The technologies can range in sophistication from simple software on a personal computer, data sharing through mobile phone technology, or an internet-based data input website, to complex sensors using global positioning system (GPS) technology. Table 8.1 compares some of the traditional methods of traceability documentation with some new methods utilizing ICT to both collect and input data, as well as to share or output data.

Because traceability requirements can impose a significant burden on the players in the supply chain, the hope is that ICT can make data input more efficient and reliable, thereby lowering the cost of verifying compliance with traceability standards. In addition, the greater ease of data output and data sharing will improve the transparency and reliability of information. These technologies will also allow consumers more access to information about the origin and processing of the products they buy. This greater efficiency and reliability of information, coupled with quicker access to the data through electronic databases and tracking systems, can allow problems in the supply chain to be identified and solved more quickly.

While investing in ICT is expected to ultimately reduce the time and resources associated with paper-based record keeping, there are often high initial investment costs involved in moving from paper-based to electronic record keeping. Therefore, finding the most appropriate technologies and learning from experience is critical for food business operators and public sector officials in developing countries. Looking at experienced markets such as Japan, which have been experimenting with ICT in traceability systems, may help the producers, suppliers, and governments in developing countries “leapfrog” directly to adoption of the most effective technologies.

8.3.5 Traceability Systems in Japan

Japan’s experience has the potential to provide lessons for other countries because Japan (i) has high standards and strict market requirements, (ii) imports a large volume of food, (iii) has a public that is responsive to food safety issues, (iv) has a production system based on small farms, and (v) uses a high technology traceability system.

Japan’s food market is notoriously hard to penetrate, due primarily to the high quality standards required by importers and consumers. Exporters who are able to meet the requirements of the Japanese market are well prepared to compete in other lucrative markets. Moreover, based on total

calories consumed, Japan imports about 60% of its food each year (USDA 2012). Compliance with Japan's food safety standards and traceability requirements opens the door to increased business opportunities.

However, in the last few years, Japan has faced numerous food safety crises, from avian flu outbreaks to dumplings contaminated with insecticide. To protect consumers, the public sector moved relatively quickly to support food safety systems. As such, the experiences in Japan can effectively provide lessons for developing countries searching for possible models. Moreover, unlike other developed countries where food production is often done on large-scale farms, Japanese farms are generally small, providing experiences that are more applicable to farms in developing countries

The high rate of information technology (IT) adoption in Japan provides a wide range of examples of ICT support in traceability systems. These examples are more relevant to developing countries than might be expected: despite Japan's high-tech image, food producers there tend to be members of a generation that is less familiar with technology. Introduction of ICT in Japanese food traceability systems has had to take into consideration the level of IT skills among the small-scale rural producers—a challenge also faced by developing countries. The public and private sectors have collaborated in addressing the food safety issues through food traceability systems using ICT. In this regard, Japan provides examples of a possible division of labor between the public and the private sectors.

8.3.5.1 The Evolution of Japanese Regulations on Food Traceability

Japanese regulations: Despite being a market known for strict food requirements, Japanese law requires a full traceability system only for rice and domestic beef.⁶ For other foods, Article 3 of Japan's Food Sanitation Law requests that each operator keep records to identify all their suppliers and customers—a “one-step-back” and “one-step-forward” record system.⁷ This request is similar to Article 18 of the European Union's EC Regulation 178/2002. However, in Japan this type of record keeping is only recommended and is not compulsory. This may change, however, as a bill requiring traceability systems for all foodstuffs is in the works in the Japanese Diet.⁸

⁶ The Japanese Diet approved a bill to require traceability records for rice and rice products in April 2009. Record keeping should be mandatory in late 2010.

⁷ http://www.japaneselawtranslation.go.jp/law/detail_main?re=&vm=2&id=12

⁸ http://gain.fas.usda.gov/Recent%20GAIN%20Publications/DPJ%20to%20Submit%20Traceability%20Bill_Tokyo_Japan_1-31-2011.pdf

Japanese Agricultural Standards (JAS): The JAS system was established in 1950 and is overseen by the Ministry of Agriculture, Forestry and Fisheries (MAFF).⁹ One of the main components of the JAS system is its compliance certification systems. Products passing inspection in accordance with the JAS requirements are allowed to display the JAS logo. These standards are voluntary.¹⁰

Originally, the JAS standards were intended to assure general product quality and standardized labeling. However, in the 1990s, MAFF expanded the JAS system to cover specific methods of production. These expanded standards, called Specific JAS, cover (i) processed meat products (aged ham, sausage, and bacon); (ii) free-range chicken (*jidoriniku*); (iii) organic foods; and (iv) other products disclosing production history and methods.¹¹

The producers and packers who wish to be certified under the Specific JAS are required to maintain records to verify production methods and segregation management. While this is not a full traceability system, it makes for a certain degree of traceability. These standards were created to differentiate high-quality products from common products and are not expected to expand to encompass the entire food market.

8.3.5.2 Improving Food Chain Traceability

Government organizations and support services. The government has taken steps to support the development of traceability systems in Japan, and in 2003, the Food Safety and Consumer Affairs Bureau was established within MAFF. Although traceability systems are not legally required except for domestic beef, MAFF policy is to encourage food business operators to voluntarily establish traceability systems (MAFF 2004, 2007).

To support this policy, MAFF has provided funding for projects such as developing traceability systems utilizing advanced ICT and formulating a handbook to guide the establishment of traceability systems. This *Handbook for the Introduction of Food Traceability Systems* was created for food business operators and aims to facilitate cooperation between the various operators

⁹ http://www.maff.go.jp/soshiki/syokuhin/hinshitu/e_label/

¹⁰ Note that certification under JAS is completely voluntary; however, quality-labeling regulations under JAS Law are compulsory.

¹¹ The JAS for “Products Disclosing Production History” is a standard used to certify food business operators who disclose information about the production methods and production history of a product. This can include information about the producers, the place of production, and usage of agrochemicals, fertilizers, feeds, and pharmaceuticals. It has been already established for beef, pork, agricultural products (rice, vegetables, fruits, and whole fresh agricultural products), farmed fish, and several processed foods.

throughout the food chain (Revision Committee on the Handbook for Introduction of Food Traceability Systems 2007). The handbook covers definitions, basic objectives of traceability, the role each operator should play to establish traceability, and how to proceed with the introduction of a traceability system. It outlines examples of general traceability systems as well as guidelines for specific food items. An English translation has been produced for overseas suppliers.

Audit and certification system. In 2005, a committee was formed by the Food Marketing Research & Information Center (FMRIC) at the request of MAFF to discuss the establishment of national certification systems and auditing standards in order to enhance the effectiveness of Japanese traceability systems. The committee released a proposed standard for food traceability systems in 2006 but in the end a national certification system was not approved. Nevertheless, some local governments have set up their own food safety certification systems that include a traceability requirement. The motivations for creating these local certification systems were diverse. Some were created to help establish a local brand, while others were meant to ensure food safety or enhance the reliability of labeling. These systems give a variety of examples of systems in which traceability is a key element (FMRIC 2008).

Pilot projects of ICT-based traceability systems. Since 2001, MAFF had been subsidizing the development and introduction of traceability systems utilizing ICT that can be used throughout the food chain (FMRIC 2006). From 2005 to 2007, MAFF spent 1 billion–2 billion yen (about \$10–\$20 million) annually on various pilot projects and studies. Examples of these experiments include (i) *integrated circuit (IC) tags* to reduce the cost of reading and recording the unique ID code of food products at each stage of the food chain; (ii) *handheld devices* to record electric data on farm inputs, processing, and distribution without paper documentation; and (iii) *web-based service technology* to keep and transfer data between server computers through the internet (MAFF 2006).

Despite the large investment in the creation of these pilot systems, only a few were adopted as viable for commercial use throughout the supply chain, as opposed to adoption by a single operator in the supply chain. One of the biggest challenges to more widespread adoption of the pilot systems is the difficulty in reaching a consensus among operators along the supply chain on what type of system to adopt. One main lesson from the pilot projects is that insufficient time and budget was allocated for consultation among stakeholders in order to form a consensus before they designed

the experimental information system. As a result, the experimental pilot projects did not fit the needs of all stakeholders in the chain. While there is no doubt that ICT will be increasingly used in the long term, in the short term, MAFF appears to be focusing on ensuring traceability through conventional paper documents and paper-based systems.

8.3.5.3 Diversity of Food Traceability Systems

Traceability systems can be broadly classified into two types (i) systems implemented by individual operators or businesses, and (ii) systems that cover operators at several stages in the supply chain.

In Japan, many types of operators have implemented traceability systems *within* their enterprises. When an individual enterprise implements an internal traceability system, it is usually not a stand-alone system. Rather, operators commonly consider traceability as the basis of a specific or integrated management system. This integrated system may include a quality management system, safety management system, inventory management system, or production history information disclosure system.

However, in order to establish a secure food chain traceability system, it is necessary to ensure consistent standards not only *within* individual organizations, but also *between* food business operators along the supply chain, from upstream to downstream. For traceability with wide-ranging applications it is also desirable to ensure consistency *across* food business operators who are at the same stage of the food supply chain, such as processors or packers. To do this, experience has shown that it is often most efficient for several food business operators to form an organization and work together to create a consistent traceability system.

It is easier to ensure traceability in cases where big purchasing operators deal exclusively and continuously with the same small-scale producers. However, the norms of open market situations are such that supply chains are fragmented with ever-changing relationships between suppliers and buyers. This reality makes it even more critical to create a consistent traceability system able to cover various, changing business relationships within the chain.

Creators of traceability systems in Japan find themselves facing common challenges worldwide (i) reaching a consensus on a traceability system that will fit the needs of all operators in the chain; (ii) creating a system that is consistent *between* and *across* operators, and not only within an individual

operator; and (iii) creating a system that addresses the fragmented nature of supply chains with many small producers and operators as well as the ever-changing relationships within the supply chains.

The two traceability systems profiled in the next sections were introduced as responses to these challenges. The first case study on dried shiitake mushrooms in Oita Prefecture evolved in response to the discovery of fraud in place-of-origin labeling, while the second case study on chicken meat in Kyoto Prefecture was a response to an avian flu outbreak. We will use these case studies to look at how these common challenges were addressed with the creation of a traceability system, as well as how ICT was utilized for efficiency.

8.4 CASE STUDY 1: DRIED SHIITAKE MUSHROOMS IN OITA PREFECTURE

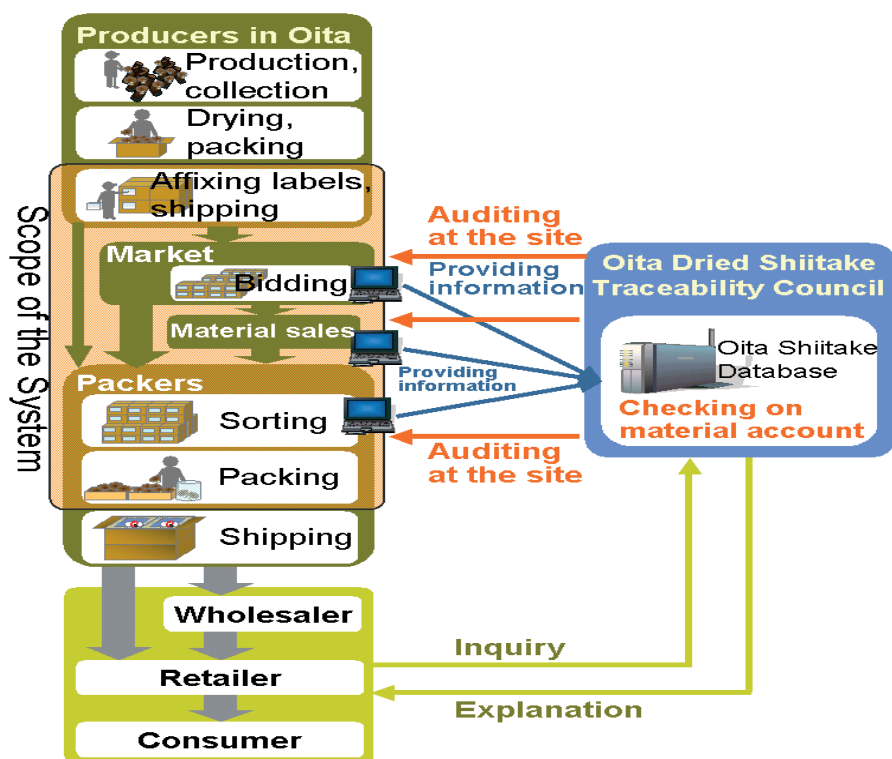
Oita Prefecture produces the largest quantity of dried shiitake mushrooms in Japan. In 2005, Oita's production was 1,395 tons, about 35% of the total 4,095 tons produced domestically. An additional 8,375 tons were imported in 2005, mainly from the People's Republic of China (PRC). There are over 4,000 dried shiitake producers and over 100 packers in Oita and nearby areas, which conduct transactions in five district markets. Most of the packers procure materials from more than one market. Therefore, there was a need for a traceability system for all the district markets and packers, including packers outside Oita.

Around 2002, place-of-origin labeling fraud was discovered on various food products in Japan, including dried mushrooms. Some dealers were caught selling dried mushrooms produced in the PRC as either "domestically produced" or without any labeling of place of origin. Thus, it became necessary to establish a system to ensure the accuracy of labeling by packers in order to gain the trust of purchasing operators and consumers.

Because the system would cover many operators along the chain, it was necessary to get the input from all the major stakeholders. In 2004, the Oita prefectural government set up the Oita Shiitake Traceability System Examining Committee, consisting of representatives of the industry including retailers and consumers. The committee commissioned the FMRIC to design a traceability system for them. The Oita Dried Shiitake Traceability Council was established to implement the system, which became operational in 2006.

As shown in Figure 8.2, the scope of the traceability system covers from the point at which the materials (dried shiitake mushrooms) are received from the producers to the point at which the materials are sorted and packed. The system is estimated to cover about 20% of all the dried shiitake mushrooms produced in Oita.

Figure 8.2 Schematic Diagram of Oita Mushroom Traceability System



Source: Food Marketing Research & Information Center.

With the introduction of the traceability system, producers affix shipping labels on the boxes of shiitake for shipping. Producers follow a producer identification (ID) system, specifying their names and location code (district/prefecture) on the shipping cards. Most producers had already been doing this, so this requirement did not result in a significant cost increase for them.

At the next step in the chain—the district market—the introduction of the new system required district market staff to input information such as the

date, packer ID, weight, and place of origin of the product into the Oita Shiitake Database. The new system required newer models of computers and software to allow the information to be accessible through the internet (FMRIC 2004). The new hardware and software cost about 2 million yen (about \$20,000) for each district market and the cost of the new computer operating system was about 5 million yen (about \$50,000).

8.4.1 Costs and Benefits of Oita's Production System

To evaluate this system as a model, we look at the major costs incurred by the key stakeholder in the chain—the packers.¹² The packers' incremental costs from introducing the new system are mainly due to the labor costs involved in the system's detailed documentation system, specifically (i) recording internal traceability, such as tracking which materials come from which boxes and what products they are then made into; (ii) setting up the printing machine and recording the necessary data to issue serial numbers for each product; (iii) recording the product's weight and quantity and entering it into the Oita Shiitake Database; and (iv) fees due to the Oita Shiitake Traceability Council.

Regarding (i), many operators simply improved existing internal documentation materials, so this step did not incur a large expense. As for (ii) and (iii), it depended on the scale of the operation, but no actual data for these added costs were surveyed. However, it is estimated that operational time increased by 10–15 minutes per person per day. Regarding (iv), in addition to the 50,000 yen (\$500) fee per year per operator, the packers also have to pay the council 3 yen per kilogram of Oita dried mushrooms they process. The revenue generated covers the costs and expenses to the council for auditing the traceability system and managing the database.

The initial costs also involved 5 million yen (\$50,000) paid entirely by Oita Prefecture for studying and evaluating the pre-traceability system situation and creating a basic plan for a new system. In addition, around 10 million yen (\$100,000), half of which was subsidized by the central government, were spent for developing the database and setting up a server.

In general, in auditing this type of proof-of-origin traceability system, the most time-consuming activity is the verification of changes in the weight or quantity of food products before and after processing or packing. In the

¹² Packers are specialized wholesalers who conduct grading, packaging, and primary processing of shiitake mushrooms.

Oita shiitake system, however, the main computer program was able to perform these calculations automatically, contributing to efficient auditing.

The benefit of the traceability system was that it increased confidence in the “Made in Oita” label. The price of Oita shiitake had already been rising during the previous years, from 2,532 yen per kilogram in 2000 to 3,449 yen per kilogram in 2005. However, in 2007, due mainly to the increasing mistrust of made-in-the-PRC food products, demand for domestically produced shiitake increased and the market price for Oita shiitake rose to over 4,000 yen per kilogram. The district market benefits directly from increases in prices, as it receives a certain percentage of the mushroom selling price as a commission. While the Oita traceability system itself did not directly affect prices of shiitake, its creation allowed the Oita shiitake industry to take maximum advantage of the increased demand for domestic mushrooms by providing an authenticated, traceable domestic product.

8.4.2 Role of the Oita Council

The Oita Dried Shiitake Traceability Council is charged with being the organizational body for a large number of operators in the shiitake food chain. It is supported by the staff in charge of promoting dried shiitake mushroom production at the Oita prefectural government office. The council represents five district markets and 34 packers (as of March 2007) and has five responsibilities. These are (i) auditing place-of-origin labeling, (ii) managing the “Oita Shiitake” logo and operator ID number, (iii) training participating operators, (iv) publicity, and (v) receiving of inquiries regarding traceability. All of this work is managed exclusively by the council staff. The following explains each of these responsibilities in more detail (FMRIC 2007).

Auditing place-of-origin labeling. Because building confidence in the place-of-origin labeling is the key function of the Oita traceability system, auditing of the system is critical. To do this, the council records the packers’ purchasing volume data (provided by the district market) with the final product volume data (provided by the packers) and compares the balance once a month. In addition, the volume of inventory held by the packers and the volume of sales among packers are recorded to confirm that all Oita shiitake can be accounted for.

The council sets a certain tolerable percentage of discrepancy between the wholesale markets’ reported data and packers’ data. As long as results are within that percentage, the operator passes the inspection. If results are not

within this range, the council office questions the operator concerned or visits the operator and checks to ensure that there have been no mistakes in the recorded data. In addition, at least once a year, the council office staff visit packers and district markets to conduct audits. For packers, they ensure that they have proper forms and documentation for internal traceability that meet the guidelines set for packers and that they keep records (ledgers, packing records, etc.) that are the basis for the amounts provided to the Oita Shiitake Database.

Managing the “Oita Shiitake” logo and operator ID numbers. Under the Oita Shiitake Traceability System, packers affix an “Oita Shiitake” logo sticker to each package. For consumers, this sticker indicates that the product’s traceability is ensured through the Oita Shiitake Traceability System and it is therefore an important symbol. The Oita Dried Shiitake Traceability Council oversees the appropriate use of the stickers and logos by the district markets and packers and assigns participating operators with ID numbers that are used on the traceability documentation.

Training participating operators. Successfully tracing the movement of food products between food chain operators relies on each operator fulfilling all the requirements of the traceability system. This includes not only understanding how the overall system works, but also becoming comfortable with the new computer software and data input methods. This is particularly important in an industry such as the Japanese shiitake industry, which involves many smallholder farmers, many of whom are older than the average worker in the country and may have less experience with ICT. Therefore, training and support of the participating operators is important for maintaining the system. The Oita system is designed in such a way that the majority of the data entry is done by a small number of staff at the packing warehouse or district market. Individual producers, therefore, are not required to invest in ICT and if necessary can still submit their data on paper for market staff to input electronically.

Publicity. Educating consumers and purchasing operators about the Oita Shiitake Traceability System is an essential part of building recognition of the “Made in Oita” brand. The council uses leaflets and has its own website¹³ to provide information about the traceability system, including the names of packers using the system, the scope of the system, and how the inspection system works. The leaflets are also given to the packers to distribute to their clients.

¹³ <http://www.oita-shiitake.info/> (in Japanese).

Receiving of inquiries. The council staff members are available to handle telephone inquiries about traceability from consumers and traders. The availability of information supports consumer understanding and confidence in the system.

8.4.3 Conclusions on the Oita Shiitake Traceability System

The Oita Shiitake Traceability System is a successful example of a system that responded to several traceability challenges that will be familiar to food business operators in developing countries:

- Creating a place-of-origin verification system.
- Creating a system that involves a large number of smallholder farmers as well as markets and packers up the food chain.
- Creating a mechanism or organization that can gather feedback from all stakeholders and plan an appropriate system.
- Creating a system that uses technology to increase efficiency at reasonable costs.
- Creating a system that uses technology that can be adopted even by those with little ICT experience.
- Creating a system that includes ongoing training and publicity, which are the foundation of consumer confidence in place-of-origin labeling.

In this case, ICT allowed the farmers to efficiently accomplish the key goal of the system: to record and compare the packers' records of product volumes. Being able to effectively verify that all shiitake volumes were accounted for as they moved through the supply chain, allowed the Oita farmers to prove the authenticity of their products. ICT allowed verification that was more efficient and transparent than a wholly paper-based system.

The implementation of the traceability system placed the Oita farmers in a solid position to benefit from the increased demand for domestic mushrooms driven by consumer suspicion of Chinese food products. For a product such as Oita shiitake, which cannot compete directly with Chinese shiitake on price, the traceability system provided the farmers with a way to compete on authenticity, quality, and safety assurance. The Oita case can be seen as a system that required minimal costs and ICT training, and yet supported the product reliability of a large number of small farmers who must compete in a very strict market.

8.5 CASE STUDY 2: POULTRY IN KYOTO PREFECTURE

The Kyoto Poultry Traceability System was chosen as a case study because it is an example of a response to a global problem—avian influenza—and it is also a system that, unlike the Oita model, heavily involves the farmers themselves with the support of local government. The Kyoto system requires a greater amount of information than the Oita case, which primarily recorded only volumes and movement. It records the kinds of poultry, the date of slaughter, and the method of delivery to the destination. In addition, this system includes an example of a method of sharing traceability data directly with customers.

In 2004, an outbreak of avian flu in Kyoto caused substantial damage to the poultry industry and required better risk management measures to restore consumer confidence in poultry products. In April 2006, producers and distributors of eggs, live poultry, and poultry meat established the Kyoto Egg and Poultry Safety Promotion Council with support from the Kyoto prefectural government.

The council conducted a consumer survey to identify what information consumers desired. The results showed that 39% of consumers wanted to know the date the poultry was slaughtered, 22% wanted to know the last day of processing, 14% wanted the name of the farm at which the poultry was produced, and 13% wanted information on the feed used. The survey also revealed that consumers were more concerned about the reliability of information than how detailed the information was. The council then created guidelines for quality management and traceability of eggs and poultry, and created a certification system for council members, who then implemented a safety management system.

The system targets poultry products that are processed by members of the council and consumed mainly in Kyoto Prefecture. The poultry is raised on farms within nine prefectures: Kyoto, Hyogo, Tottori, Shimane, Okayama, Hiroshima, Tokushima, Kagawa, and Ehime. It is then slaughtered and processed at six poultry handling plants. The products are transported by refrigerated truck to retail stores in Kyoto and Osaka Prefectures (27 locations). Currently, this distribution accounts for about 10 tons per day (6 tons of thigh and 4 tons of breast meat).

8.5.1 Record Keeping at Each Production Stage

The operators at each stage in the food chain (farming, slaughtering, processing, and retail) determine the lot size and give it an ID number. A lot is typically defined as poultry treated in a single day at a particular site. The site can determine smaller lot sizes if it so desires.

At each stage, the operators record essential traceability information such as the ID numbers of the lot, as well as the ID numbers of the suppliers and customers of the lot. Each operator not only keeps these records at its site but also supplies an electronic version of the records to a central server maintained by the council.

Operators at each stage keep records of their production history, as well as inspection data. For example, farms keep records of *salmonella* inspections,¹⁴ vaccine inoculations, information regarding hygiene control, the introduction of new chicks, feed expenditures, and daily feeding management operations. These records are not made available on the server but are available at the farms if a problem needs to be investigated.

8.5.2 Costs and Benefits of the Kyoto Poultry Traceability System

To lower costs, the council designed the traceability system in way that would minimize the amount of information that needed to be collected and shared. This was done by carefully planning and defining the information to be collected, through consumer surveys and feedback from the stakeholders.

Costs to slaughter and processing site. The slaughtering and processing sites needed only to acquire a personal computer, a label printer, and a database server as their initial investments. Installing the appropriate software and hardware required funds on the order of 2 million yen (about \$20,000) per site. The running costs at each slaughter and processing site total about 200,000 yen (about \$2,000) per year. These annual costs can be broken down into membership fee of 50,000 yen per year, labels and printing supply costs of 40,000 yen, internet connection and server maintenance fees of 50,000 yen, and usage of a system developed by Mitsubishi Electric Corporation to stamp certified times and locations on products at 60,000 yen.

¹⁴ *Salmonella* is a class of bacteria that can cause severe food poisoning in humans. One common way it can be contracted is through raw or undercooked eggs, or through poultry meat that is infected or has not been properly processed.

Costs to retail store. The initial costs for a retail store were also about 2 million yen, the same as the initial costs for a slaughter and processing site. For small stores, the system can be implemented with only a “relay” label printer. This will provide the label used at the retail level that includes information such as the product identification number, barcode, and receiving date. In this case, initial costs can be limited to 600,000 yen. In addition, the running costs of retail stores include the membership fee of between 20,000 yen and 50,000 yen, labels and printing supply costs at 40,000 yen, internet connection and server fees at 50,000 yen, and time and position certification usage fees at 60,000 yen. These running costs can total from 60,000 yen (for those who only install the relay printer and do not transfer data electronically) to 200,000 yen (for complete functionality).

8.5.3 Ongoing Role of the Council

The council is promoting the system to attract more businesses to adopt it. Ultimately, the goal is to cover the operators at all stages in the poultry supply chain and all businesses across each stage. The greater the number of operators this system covers, the more reliably it can track the movement of poultry products.

As part of their goal to achieve transparency throughout the entire traceability system, the council’s system for eggs is already subject to audit and review by third-party inspectors. The council is planning to subject its poultry system to these same actions.

The successful establishment of a traceability system for Kyoto poultry was a factor in helping to restore consumer confidence in poultry. As the traceability system has been set up to allow consumers to directly access product history information through a website, in December 2007, the site was viewed by businesses about 10 times per day, while views via mobile phone numbered about three to five per day.

Feedback to the council has shown that customers, including consumer cooperatives and catering businesses for schools and hospitals, are satisfied with the system. However, chicken prices have not increased, at least in part due to the fact that there has not been another widespread avian flu outbreak in the area. Thus, products traced through the Kyoto system have not been able to command higher prices than products outside the system. However, with the Kyoto system in place, the participating operators are prepared for any problems within their food chain and will be able to

minimize damage to themselves through rapid responses or will be able to benefit from product differentiation (Sasaki 2007).

8.5.4 Conclusions on the Kyoto Poultry Traceability System

The Kyoto Poultry Traceability System, like the Oita system, is an example of a response to several common challenges:

- Creating a traceability system in response to disease risks within the food supply.
- Creating a system that aims to lower the risk of a public health concern
- Determining exactly what information is necessary to be collected and shared.
- Creating a system in which ICT costs can be adjusted for the size of the participating business.
- Creating methods of sharing information directly with consumers and buyers.
- Creating a system that includes ongoing publicity to recruit new participants.

Like the Oita shiitake packers, the Kyoto poultry businesses are now prepared for food supply crises. The Kyoto operators have reduced the financial risk to their business from a poultry supply safety incident, such as further outbreaks of avian flu. In contrast to the Oita system, the Kyoto system has a higher level of involvement for producers in the data collection. For the Kyoto system, collecting and sharing production history data quickly in order to promptly respond to any disease outbreaks was an important goal of the traceability system. ICT allowed the Kyoto chicken industry to input, access, and share this critical information much more quickly and broadly than a paper-based system could, and therefore ICT is a critical element in the efficiency of this traceability system.

As an example of a system that addresses a public health risk, the Kyoto system also shows successful synergy between the national government, local government, and private sector. Funding was balanced between the industry and the local government and the Kyoto system used a variety of ICT, including the Mitsubishi stamp system. Systems such as this, which address public health issues, will demand higher costs than the more simple place-of-origin verification system needed for Oita shiitake. However, it is expected that the investment by both the private and public sectors to prevent public health crises such as avian flu are worthwhile in the long run.

The Kyoto system also shows examples of how to use simple ICT at low cost—websites and mobile phone sites—to give consumers direct access to product history information. Finally, the Kyoto Poultry Traceability System gives an example of an effective use of consumer surveys to carefully identify the information required to collect and share in order to build consumer confidence. Without the surveys and planning, time and resources might have been spent collecting unneeded information or crucial information might not have been recorded.

8.6 LESSONS FOR DEVELOPING COUNTRIES

Traceability has become a key word in the global food industry due to increased incidents of food contamination and false labeling of place of origin or ingredients, resulting in increased public distrust of food safety. With their economic interests at stake, the private and public sectors in developed and developing countries are looking into establishing traceability systems for food supply chains in order to regain consumer and importer confidence and reduce the risk of future problems.

Implementing a traceability system does not, in itself, ensure food safety; it does allow a more rapid and efficient response to food safety problems, enabling quick identification of problem sources and their location in the supply chain. Well-planned traceability systems have been shown to improve efficiency in the management of the supply chain for both the public and private sectors. Having reliable information about the movement of food within the supply chain also means that, in the event of a food safety incident, the source of the problem can be more quickly identified and appropriate action taken. Unsafe products can then be pulled out from the market while products traced to safe sources can remain, limiting both the danger to consumers and economic damage to the food industry. Traceability also allows the verification of compliance with labeling regulations, making it an important element for the supplier in obtaining the trust of buyers and consumers. It is expected that traceability systems will be increasingly adopted worldwide.

In reviewing the development of traceability systems in Japan and taking a close look at case studies in Oita and Kyoto Prefectures, we make the following recommendations for developing countries:

- With the global trend of increasingly strict standards and traceability requirements, investment in traceability systems is essential to ensure ongoing access to the markets in the developed world. Establishing

traceability systems will help ensure that products not only meet WTO export requirements but are prepared to meet the requirements of the stricter private sector buyers—requirements that can function as trade barriers to products from developing countries.

- Traceability systems strengthen industries and prepare them to handle future supply chain crises or changes in market dynamics. An efficient traceability system lowers the risk posed by potential accidents or market threats and is therefore an important investment for industries aiming to compete in the global market.
- Traceability systems improve transparency throughout the supply chain and ultimately lower the transaction costs associated with recording, transferring, sharing, and querying information. Transparency and lowered transaction costs encourage sustainable supply chains, which are the foundation of environmentally and socially sustainable production and processing practices.
- Traceability systems gain the confidence of not only international buyers but also domestic consumers who are increasingly concerned about food safety. Traceability systems can allow for direct communication with the public in the producing and buying countries, a type of communication that is increasingly in demand throughout global markets.
- Traceability systems can improve business efficiency throughout the supply chain by quickly and accurately recording, sharing, and reporting information. This efficiency can ultimately improve profits, a benefit to both the domestic industry in developing countries and their international trade partners.

Japan's experience in utilizing ICT to make input and output of data more efficient and reliable also provides some broad lessons:

- *Traceability systems help prevent food safety crises and food scandals.* In both case studies in Japan, the traceability systems allowed the industries to strengthen their business and to prevent shocks to the industries from food scandals or crises in the sector. The value and effectiveness of a traceability system becomes clear when there is a food scandal (e.g., false information on labels), putting the industry in a crisis situation. The two Japanese industries discussed in this chapter have not faced a crisis since the introduction of their traceability systems. However, especially in the Oita case, the introduction of a traceability system allowed the industry to take advantage of market opportunities when consumers became distrustful of products grown overseas. The traceability system strengthened the industry.

- ***ICT supports efficient traceability throughout the supply chain.*** Creating and running a traceability system requires coordination and agreement among the businesses at all stages of the supply chain. The case studies illustrate that ICT allowed the industries to do something they had not been able to do before: quickly and efficiently share information related to their key concerns. In the case of shiitake mushrooms in Oita, this was related to tracking product volumes in order to verify place of origin. In the case of poultry in Kyoto, it was sharing information on production history. ICT allowed for faster and more efficient sharing of information between different stages of the supply chain than a paper-based system could provide.
- ***Cooperation within the industry is essential.*** The two case studies showed that for a traceability system to be operational, cooperation among stakeholders in the supply chain was essential. There was a need to first establish a body responsible for gaining agreement and consensus within the supply chain. An association of traders, producers, or processors of a specific food product can often play this coordinating role for all the small stakeholders in all stages of the supply chain. For establishing this coordinating body, public sector involvement was essential. Once established, the public sector role was diminished and the governing body could take on the role of maintaining the system, supported by member fees.
- ***Traceability systems must be considered a long-term investment.*** The key advantage to using ICT within a traceability system is that it allows information to be digitized for faster utilization (i.e., transfer, share, query, and analysis of data). The initial investment in ICT hardware, software, training, and maintenance can be a considerable cost. However, all indications suggest that ICT-based systems are safer and more reliable than paper-based systems. In this way, not only will transaction costs be reduced through faster transfer of information, but safer systems will also lower the risk industries face from supply chain accidents. A safe traceability system can be seen as a worthwhile investment for industries in developing countries that are aiming to compete globally in the long term.
- ***IT illiteracy among farmers is not a constraint.*** One of the main concerns regarding the use of IT at farm level is that farmers in developing countries are not IT-literate. However, lack of IT literacy was not a constraint in Japan even though farmers in rural Japan are generally older and are not necessarily IT-literate. With a combination of farmers or representatives of farmers' organizations reporting in paper form and a small number of staff to input the data electronically, an effective traceability system can be established.

- ***Public funding is crucial for inclusion of small players.*** Experience in Japan shows that large companies often have the resources and motivation to invest in their own internal traceability systems to increase their efficiency and reliability in the market. However, for building systems that involve multiple stages of the supply chain and include smaller suppliers, public funding is crucial. In Japan's case, local and regional governments have often provided the initial support for establishing and testing the systems and producer associations have often provided the coordination among the businesses. One key lesson is that the amount of resources needed to support adequate consultation among stakeholders is often underestimated. This can lead to a lack of consensus among traceability system stakeholders.
- ***A well-planned central database influences the cost effectiveness of the system.*** Because traceability systems vary depending on the characteristics of the food products and the distribution routes being traced, the scope of a traceability system and its data needs can vary widely. The needs of the industry and its goals should determine the size and structure of the central database. A crucial part of planning a traceability system is carefully researching and agreeing on what data are needed, how they will be inputted, and how to provide the output. In case of export products, traceability information should be made easily available in the major importing and exporting countries of the products.
- ***Outreach and education is essential.*** Traceability systems are most effective when all business in the supply chain, both vertically and horizontally, participate in the system. The outreach and promotion of the traceability system must be part of the system's maintenance. Promotion not only attracts more participants to the system, which ultimately increases the number of traceable supply chains, but also educates consumers on the reasons for the sometimes higher price tags of traceable products.

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9. International Supply Chain Management through Contract Farming: Experience of Japanese Firms in Selected Asian Countries

Sununtar Setboonsarng



9.1 INTRODUCTION

Trade liberalization, infrastructure development, and regional economic integration are leading forces in changing economic and social relations across the world. In the rural areas of developing countries where poverty is prevalent, the private sector is playing an increasing role in poverty reduction (ADB 2000, IFAD 2001, Hayami 2003, Setboonsarng 2008), in many instances through institutional arrangements such as contract farming, which has emerged as a promising development tool to provide market linkages for smallholders, a role traditionally reserved for the public sector.

With increasing food safety and environmental concerns, particularly in developed countries, the global demand for organic food and drink has been one of the most rapidly growing sectors in the food industry, estimated to have tripled from \$17.9 billion in 2000 to over \$62.9 billion in 2012 (Willer, Lernoud, and Kilcher 2013). Global sales of organic food and beverages represented approximately 4% of overall food and beverage sales in 2010 (OTA 2011).

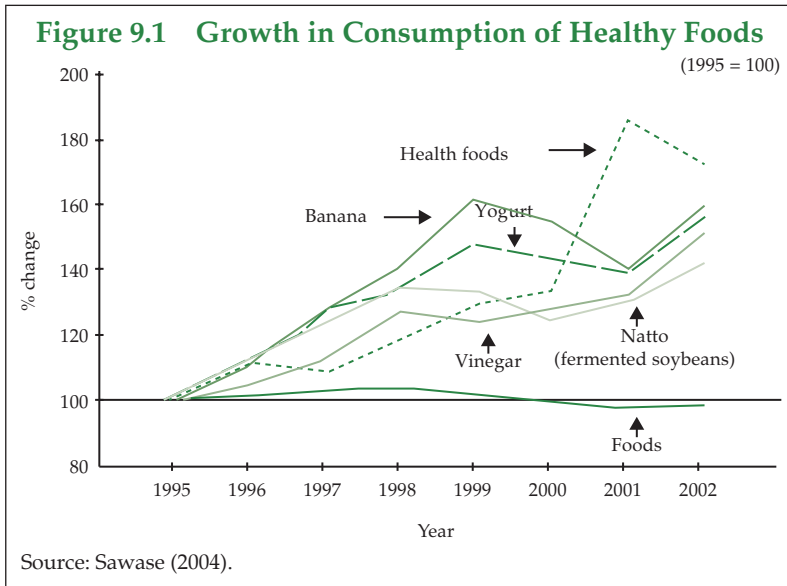
In 2007, the market for fairtrade products, which usually include green products, also expanded by 47% (\$14 million) (Organic Monitor 2008). As globalization deepens, changes in consumer preferences in developed countries are rapidly reflected in the changes in production pattern of producers in developing countries, largely through vertical integration of supply chain and contract farming of green food. This arrangement provides employment for farmers and quality products for firms and formed a basis for a successful commercial culture and eventually agribusiness industry (Glover and Kusterer 1990, Key and Runsten 1999, Eaton and Shepherd 2001). Farmers under contract farming of green food may also stand to be rewarded with substantial improvement in farming systems, premium prices, market access, and less exposure to toxic agrochemicals (Setboonsarng 2008).

In addition to addressing concerns of consumers in export markets, international trade in food products is also governed by the World Trade Organization's Agreement on the Application of Sanitary and Phytosanitary (SPS) Measures and the Agreement on Technical Barriers to Trade. This has prompted food-exporting countries to look into ways of upgrading the production and supply chain of food and agricultural products to maintain and improve their competitiveness in the global market.

With Japan as a top food-importing country in the world, this chapter reviews experiences of Japanese import firms in managing the international supply chain and explore the potentials and constraints on how they could reduce rural poverty. Summaries are presented of case studies conducted by the Japan External Trade Organization (JETRO) on Japanese firms doing business in the People's Republic of China (PRC), the Philippines, Thailand, and Viet Nam. This chapter also draws information from primary and secondary sources on experiences of Japanese agribusiness and/or trading firms doing business in selected Asian countries. Also reported are results of a survey of Japanese food trading firms importing food from Cambodia, the PRC, the Lao People's Democratic Republic (Lao PDR), Thailand, and Viet Nam. The survey, in particular, examines the extent to which contract farming is used to ensure stable supplies that meet the product specifications of Japanese consumers, especially mechanisms to ensure food safety. It also investigates the motivations underlying the firm's country of choice for investment and how the institutional arrangement between contracting firm and contracted farmers can be improved.

9.2 THE CONTEXT: A MATURE MARKET AND EMERGING PRODUCERS

Japan is the world's biggest net food importer with purchases valued over \$76 billion a year (Biggs and Sakamaki 2008). Almost half of its food imports are agricultural products estimated at \$30 billion annually (USDA 2006a). Despite a strong protectionist policy and a preference for local products, the country's food self-sufficiency rate was only 39% on a calorie-supply basis in 2006, the lowest among major industrialized countries (Yoshida 2008). The sheer size of its market offers big opportunities for exporters, especially from the developing world. With strong purchasing power, Japanese consumers play a vital role in determining the kind of produce and the choice of production systems in exporting countries.



9.2.1 Growing consumption of healthy food

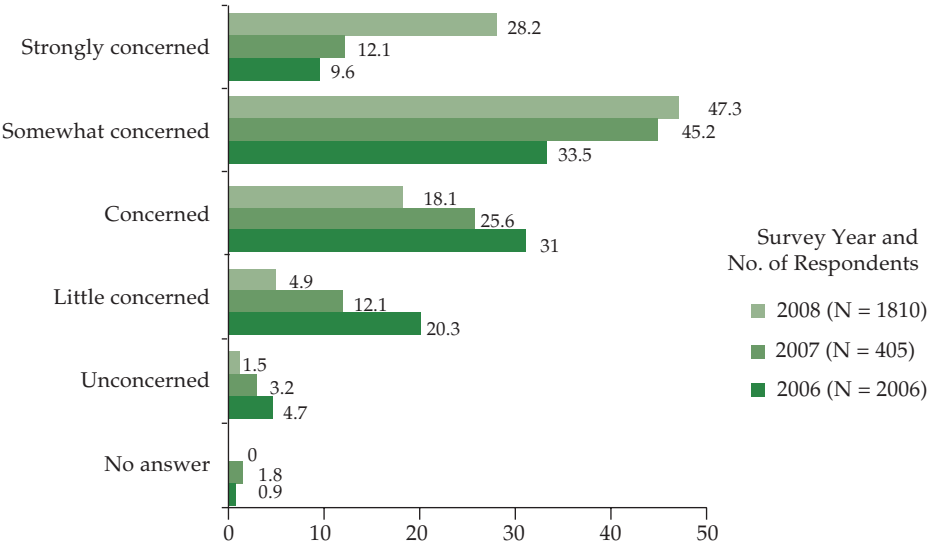
During the past decade, demand for food perceived as “good for health” has been growing rapidly in Japan as consumers are becoming increasingly health-conscious as shown in Figure 9.1. This trend is more pronounced in the upper-middle and higher-income groups and typically among females in their 30s or 40s with children (Lohr 2001).

Among the food perceived as “good for health” is organic food, the most well defined, regulated, and developed market in the food sector. Although the share of organic food in Japan was only 0.15% of total food production in 2002, an upward growth trend has been projected and was estimated to have reached \$6.0 billion in 2007, an increase of 113% since 2002 (RocSearch 2004).

9.2.2 Food safety concerns

While price and packaging are still important drivers of consumer purchases in Japan, recent food scandals such as false labeling incidents and high pesticide levels found in imported products have highlighted food safety. Increasingly, Japanese consumers have become more concerned about food safety as revealed by survey results in Figure 9.2. The recent Fukushima nuclear debacle has heightened consumers’ food safety concerns in 2011. This sentiment is echoed in the results of Nikkei Survey of March 2012 revealing 70% of respondents being highly concerned about contaminated food.

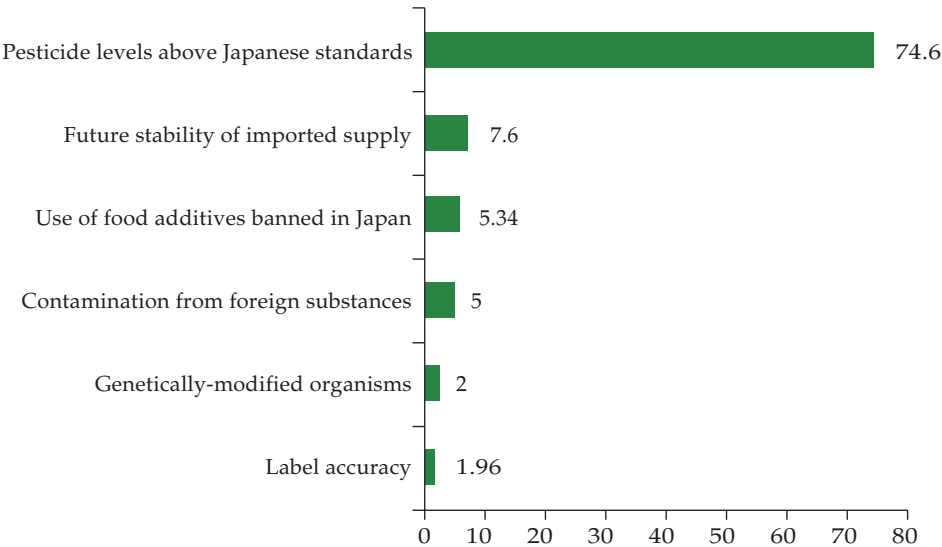
Figure 9.2 Level of Concern on Food Safety of Japanese Consumers (%)



N = number of respondents.

Source: Data for 2006 and 2007 from Food Safety Commission (2006 and 2007); data for 2008 from Cabinet Office of Japan (2008).

Figure 9.3 Dominant Safety Concerns on Food Imports into Japan (%)



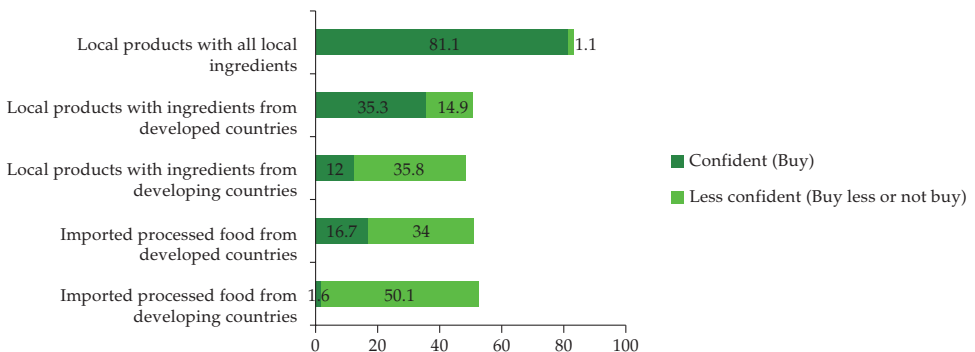
Source: Food Safety Commission (2003).

A survey carried out by the Japanese Food Safety Commission in 2003 on sentiments of consumers on imported food ranked pesticide levels higher than the standards as the top concern (Figure 9.3). Other concerns include food contamination and banned additives.

As such, many Japanese firms prefer to use domestic products in processed foods (Sawase 2004). Imported products, particularly from developing countries are often perceived as unsafe and are unable to meet Japanese standards. These sentiments were reflected in the results of Survey on National Lifestyles 2008 conducted by the Japanese Cabinet Office on people over age 20 (Figure 9.4).

Japanese consumers are demanding goods produced using less or no chemicals and have greater requirements for product traceability¹ and certification, which are likely to pose serious challenges on exporters from developing countries. In response to food safety concerns, a number of new laws and regulations were issued. In 2003, the Food Safety Basic Law that established the Food Safety Commission (FSC) was reenacted and the Food Sanitation Law was revised. Then, in 2004, several related laws and standards were also revised, such as the Pesticide Control Law, Pesticide Residue Standard, Japanese Agricultural Standards (JAS), and Guidelines for the Labeling of Specially Grown Agricultural Products. In 2006, the number of chemicals with maximum residue limits increased from 283 to 799 (MHLW 2006).

Figure 9.4 Confidence Level and Purchases of Local and Imported Food (%)

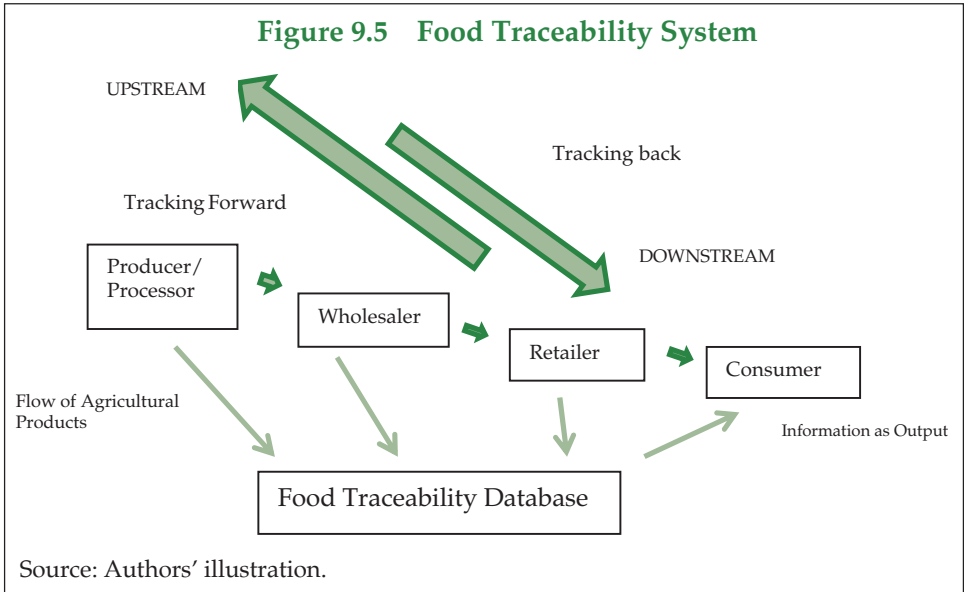


Source: Cabinet Office of Japan (2008).

¹ Nokyo Ryutsu Kenkyujo (2004b) reports that 48% of producers and vendors in the market have already established their own traceability systems.

9.2.3 Increasing demand for traceability

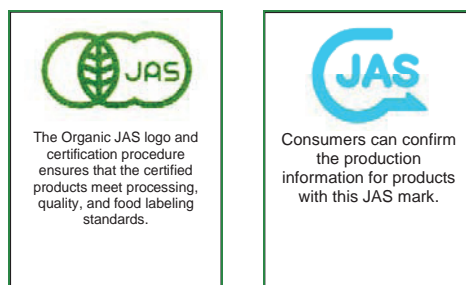
The tightening of laws and regulations on food safety is accompanied by an increasing demand for product traceability. Figure 9.5 shows a basic model of traceability systems allowing information to flow from producer to consumer. Modifications to the system made possible consumer feedback to reach producers.



In a consumer research poll conducted by the Yomiuri Shimbun, 81% of the respondents expressed an interest in mechanisms allowing them to trace food producers (Yomiuri Shimbun 2004, as cited in Cuthbertson 2005). Stricter measures to ensure authenticity of traceability system are also set in place. For instance, a new JAS standard (Figure 9.6), according to which a third party certifies the accuracy of production information of foods, has been issued.

In this system, a producer must provide detailed and accurate documentation of origin, movement, processes, and other relevant product attributes to be certified. Local producers are expected to use the program to differentiate their products from imports (ATO 2004a, 2004b). Furthermore, in 2005, the Ministry of Agriculture, Forestry and Fisheries (MAFF) set a nonbinding target for 2008 expecting traceability of about half the total production and distribution records on fresh food and low-processed food within 24 hours at major stores (Sudo 2005).

Figure 9.6 Organic JAS Logo and New JAS Standard Logo



JAS = Japanese Agricultural Standards.

Source: Ministry of Agriculture, Forestry and Fisheries.

Box 9.1 Traceability Systems in Japanese Supermarkets



In-store terminal shown on the right is what supermarkets such as Ito Yokada Co. Ltd have started to employ in Japan. Ito Yokada Co. Ltd is a general supermarket chain with 176 stores nationwide. To maintain consumer confidence, it ensures safety and freshness of its products through its own procurement and traceability systems. Purchases depend on confirmation of production locations and methods. The company performs its own pesticide residue testing in producer countries, and in warehouses in Japan. The company is also building its own traceability system to manage production and distribution history. In the case of imported chicken from the People's Republic of China, the company can specify the source poultry farms, and check feeds and drugs used at each farm. They are also building their own traceability system to manage up to the transportation of chicken. They also have locally posted staff and buyers to periodically check production conditions on site at each poultry farm.

Source: FoodEx Japan.

Pushed by consumer demand and regulatory developments, big names in retail have already started to implement traceability systems allowing consumers to check production information. Using the identification number on the product's package, consumers can check production history details either by using an in-store terminal (Box 9.1) or the internet, as implemented by Ito Yokado, one of Japan's top retailers in 2002.²

² Footnote 1.

To secure a place in the Japanese market, imported products should meet strict Japanese standards for food safety and traceability. However, Asia in general, is still at an early stage of formalization, with very few production norms or regulations implemented in most countries (Commins and Wai 2003). Among the Asian countries covered in the survey, only the PRC and Thailand have established standards for grading and certifying green products. Thus, Japanese firms impose their own standards based on the host government's regulation for food production, often through contract farming arrangements (Nokyo Ryutsu Kenkyujo 2004a).

9.3 JAPANESE CONTRACT FARMING EXPERIENCE IN SELECTED ASIAN COUNTRIES

This section provides country background and reviews the initiatives in contract farming for exports of Japanese firms in selected Asian countries based on the JETRO case studies.

9.3.1 Thailand

Of the countries covered in this study, Thailand has the longest experience in private sector-led contract farming (Glover and Ghee 1992). Promoting contract farming has been a policy of the Thai government since the 6th National Economic and Social Development Plan (1987–1991), although contract farming schemes existed long before that (Singh 2005, Wiboonpoongse and Sriboonchitta 2008).

Japanese investment in agricultural production and the food industry now has almost half a century of experience. Starting with the importation of raw agricultural products in the 1960s–1970s, Japanese firms started to invest in vegetable and shrimp production in the 1970s–1980s. In the 2000s, processed food was added to the list of major exports (JETRO 2002a). Thailand has also been actively pursuing contract farming as an area for regional economic cooperation in the Mekong region, allowing tariff-free importation of all approved agricultural products produced under contract farming in the region.

According to JETRO, Thailand's success as an agricultural exporter lies in three areas: management and marketing, infrastructure, and government policy. There was also an effective transfer of new technology from Japan. Thai farmers had to adapt to meet the requirements of foreign markets, specifically the Japanese market. Thai firms were also adaptive to changing times. When Thailand experienced wage hikes in the 1980s, local ventures

started to convert labor-intensive crops to high-value products with fewer labor requirements, such as processed food (JETRO 2002a).

Thailand's well-developed infrastructure and favorable business climate greatly encouraged foreign investments. The private sector also has the support of both the central and local governments. For instance, the Board of Investment (BOI) of Thailand exempts authorized foreign investors from tariffs and other tax payments. Some local governments also encouraged processing factories to get accreditation from international sanitary and quality certification organizations, such as Hazard Analysis and Critical Control Point (HACCP) and the International Organization for Standardization (ISO) (JETRO 2002a).

There has also been a strong movement supporting chemical-free agriculture and organic agriculture in Thailand starting in the late 1970s, largely as a nongovernment organization (NGO) response to the failures of the green revolution. The movement gained state support in the 8th National Economic and Social Development Plan (1997–2001), establishing the first national policy framework for sustainable agriculture, including organic farming. The plan targeted the conversion of 20% of total arable land for sustainable agriculture. In 2001, the government announced a policy directive to make Thailand the Asian hub for organic products. Two years later, the National Agenda on Organic Agriculture was officially launched, which set the goals on reducing chemical fertilizers and pesticides by 50% and increasing the number of organic farmers to over 500,000 and their incomes by 20% by 2006. More recently, the active facilitation of the Thai government in addressing food traceability system requirements has attracted many Japanese firms to relocate their production to Thailand.

9.3.2 People's Republic of China

Japanese investments in agribusiness in the People's Republic of China (PRC) (Quiao 2005) started in the 1980s and have grown very rapidly since then, surpassing the levels in Thailand in 1993. With the country's favorable agroecological condition for vegetable production, this has encouraged the central and local governments to form 10 vegetable production centers in coastal regions where the level of infrastructure has been improved and is better than the average (JETRO 2002b).

The production of green or "eco-labeled" products was largely a response to growing food safety and environmental concerns in the early 1990s. To expand the market reach of green products abroad, several certification

standards have been issued by the Ministry of Agriculture since 2001. The National Organic Standards then took effect in 2005. According to Zola (2004), Japanese supermarkets have been experimenting with vegetable production in the PRC for 8–10 years, but it is only in the past few years that quality has been good enough to allow large-scale sales to Japan. He added that farmers are now using Japanese seeds and technology in vegetable production, making their products almost indistinguishable from the Japanese ones.

In recent years, private sector-led contract farming in the PRC has enjoyed a rapid expansion. Guo, Jolly, and Zhu (2005) noted the following promising trends:

- The number of agricultural products produced under contract has increased steadily from small-quantity locally specialized products to bulk commodities such as corn, beans, rice, or wheat.
- The geographical distribution of contract farming has expanded significantly, now spreading to underdeveloped areas of central and western PRC.
- Cultivated areas involved in all types of contracts have increased, reaching 18.6 million hectares in 2001.
- The number and complexity of contracts have increased, with new contracts going beyond standard production and marketing arrangements. They now include food purchases from major producers and seed production in research institutes.

However, Japanese standards have become ever more stringent. In a study by Chen, Yang and Findlay (2008), their analyses show that PRC's exports of agricultural products are negatively affected by safety standards imposed by importing countries. Despite these temporary setbacks, the PRC has been able to expand its share in the Japanese market. The PRC is the second largest exporter of food products to Japan at 17% of the total, trailing the United States (US) at 22% (JETRO 2006).

9.3.3 Viet Nam

Japanese investment in Viet Nam's agriculture sector started after the economic reform known as Doi Moi³ in 1986 (JETRO 1999a). Under the country's Ten-Year Socio-Economic Development Strategy (SEDS) from 2001–2010, large-scale commercial production by state-owned or private

³ Details can be found on the Profil website; available at [http://www.laosorganic.com/pdf/Organic%20Standards%20Final%20%20Version%20\(eng\).pdf](http://www.laosorganic.com/pdf/Organic%20Standards%20Final%20%20Version%20(eng).pdf)

farms have been designated for export crops. The strategy also included production guidelines for green food, i.e., using limited chemicals and clean technologies in the cultivation and processing of vegetables, fruits, and other foodstuffs.

The alternative agricultural movement in Viet Nam was successfully led by the National Association of Vietnamese Gardeners (VACVINA), a semi-NGO with support from the government. Although private sector-sponsored contract farming is a fairly recent development in Viet Nam, the government has been quick to implement measures promoting it. In 2002, the Prime Minister signed a policy encouraging enterprises from all sectors to contract with farmers (Lem et al. 2004). Months succeeding the announcement witnessed a substantial increase in contract farming arrangements (Anh 2004).

The JETRO report examines 14 agribusiness firms—9 state-owned and 5 private agribusiness firms. The study revealed a notable contrast in managerial abilities and product quality between state-owned and private firms. Two major management problems were found in state-owned firms, i.e., inadequate soil management and quality control. As expected, the quality of produce did not meet Japanese standards. Although some farms cultivated high-quality produce, inadequate transport and storage facilities hastened the spoilage of produce. Poor sanitation was also pointed out as a problem in the processing factories.

By contrast, soil management in privately contracted farms was well controlled. Some firms introduced organic fertilizers to improve soil quality; others even pioneered the use of Japanese varieties and adapted them to local conditions. They also investigated Japanese market and product standards with some establishing their own in the absence of national standards to control size and sanitation. Problems on contract enforcement, such as redirection of inputs and cash advances, were cited (JETRO 1999a).

9.3.4 Philippines

Japanese investment in agricultural production and the food industry in the Philippines started in the 1960s, mainly with bananas and pineapples. Introduction of Japanese crops was proven unfeasible due to the long rainy season and typhoons. Since there was no domestic standard for agricultural products, Philippine farmers were unfamiliar with techniques to control the size of produce, thus they had irregular shapes that did not meet Japanese standards.

JETRO (1999b) identified three main causes of the withdrawal of the Japanese contract farming operations from the Philippines (i) redirection of inputs and cash advances provided under the contract, (ii) inability to control quality of products, and (iii) high domestic transportation cost. These problems prompted investors to move to Thailand and Malaysia, and later to the PRC, in the 1980s–1990s.

9.3.5 Cambodia

Cambodia is on its way toward a market-led economy, largely driven by traders and service providers. Several private sector-led initiatives had their start in the rural areas, one of which is contract farming (McNaughton and Sophanna 2003). The response to a growing demand in the export market for low-chemical input products has given a boost to this arrangement.

Since the 1990s, the Government of Cambodia, in partnership with NGOs and donors, has embarked on a pro-poor trade development strategy to reduce poverty by enhancing the capacity of farmer groups to export agricultural products. Donors have also been active in supporting NGOs. The European Union, for instance, has assisted in the task-force formation for organic and genetically modified organism (GMO)-free agriculture and the development of Cambodian national standards for organic production (Makarady 2005).

9.3.6 Lao People's Democratic Republic

By and large, farmers in the Lao People's Democratic Republic (Lao PDR) still practice low-input sustainable agriculture (LISA). The country's hill and plateau topography gives the farmers an opportunity to produce exportable "out of season" fruits and vegetables (Chittanavanh 2005).

In 2004, the Swiss Association for International Cooperation (HELVETAS) started a project for the promotion of organic farming and marketing in the Lao PDR, covering all aspects of production, processing, and marketing and support for the development of national organic standards (Lao PROFIL 2004). The Lao PDR's organic standards are based on the fundamentals of the International Federation of Organic Agriculture Movements (IFOAM) fundamentals and Agriculture Certification Thailand (ACT).⁴

⁴ The Asian Development Bank Institute's research initiatives on contract farming and poverty reduction have converged on the choice of contract farming for green products as the most appropriate strategy for Cambodia and the Lao PDR. Both countries already have the comparative advantage of producing green products under traditional methods, using very little or no chemical input. However, the infrastructure and institutions needed to facilitate market exchange are not well established. In this context, contract farming has emerged as a promising tool to promote market development in both countries.

The main export markets are the PRC, Thailand, and Viet Nam with a few Japanese firms exploring the possibility of importing organic coffee from the Lao PDR. Products are purchased directly from the farmers by established trading companies, many of which are joint Lao PDR–Thai ventures.

9.4 SURVEY

To assess the extent to which globalization in Asia has led to increased linkages between consumers in Japan and farmers in developing Asian countries, a mail survey was conducted on Japanese firms currently importing green food products from five Asian countries (the PRC and countries in the Mekong region, i.e., Cambodia, the Lao PDR, Thailand, and Viet Nam).⁵ The Lao PDR and Cambodia were included to understand the perception of Japanese firms of these two countries' high potential for green food production. The survey was conducted from July to August 2005, in cooperation with the Tokyo–Mitsubishi UFJ Institute.

The survey also investigated the mechanisms that Japanese firms adopted to ensure compliance of applicable Japanese agricultural laws and guidelines, to identify perceived constraints and challenges of agricultural investments, and to explore the extent of technical assistance to producers.

9.4.1 Data Sample

The firm samples were obtained using the latest directories of business associations at the time of survey. Survey instruments were mailed to 742 companies and obtained 59 valid⁶ questionnaires, an effective response rate of 8%.⁷ Although the valid response rate may appear low, it is not a low rate for a survey of this nature in Japan, where disclosure policies may have hindered firms from participating or filling out the questionnaire completely, accounting for the high rate of “no response” answers. Self-selection biases resulting from the large percentage of nonresponses are likely to be present.

To address the limitation of the questionnaire survey, additional telephone interviews were conducted to clarify and/or request missing information. Follow-up face-to-face interviews with four firms provided helpful insights, enriching the quality of information from the survey.

⁵ The term “valid” is used here to indicate that the response meets the requirements of the study as opposed to “usable” which may imply that the other questionnaires cannot be used at all.

⁶ Please refer to Table A4.1 of Appendix 4 for the sector distribution of the 742 survey instruments.

⁷ Please refer to Figure A5.1 of Appendix 5 for the distribution of the sampled firms by industry and by capital size.

9.5 SURVEY RESULTS

The results presented below reflected the state of affairs of Japanese agribusiness companies in selected Asian countries at the time of survey.

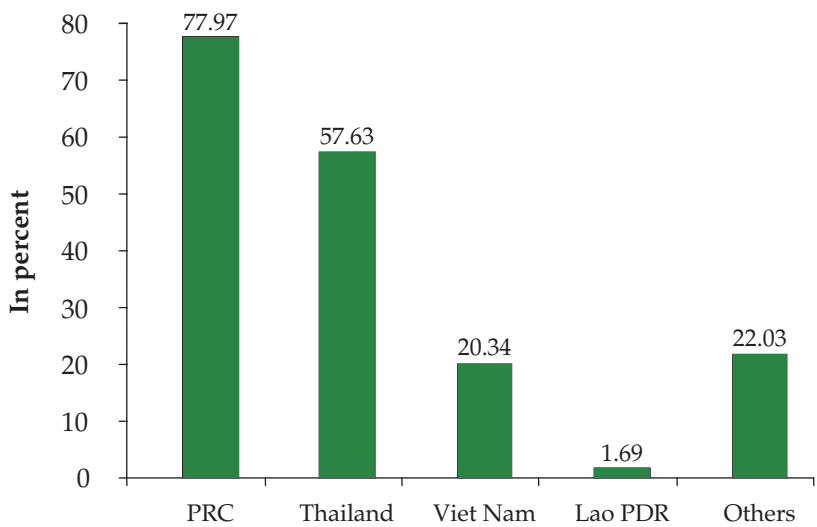
9.5.1 Respondents' Profile: Sector and Capital Size

The food processing firms formed the majority of surveyed respondents, accounting for 37% of the total, followed by the food retailers group at 29%. Less than three-quarters (70%), or 41 firms, disclosed their capital size. Of the 41 firms, 15 had a capital size of between 100 million yen and 1 billion yen, and two large firms reported capitalization of 100 billion yen or more in 2004.⁸

9.5.2 Trading Partners and Imports

As shown in Figure 9.7, of the 59 firms under study, 13 firms or 22% did not disclose their trading partner. Of the remaining 46 that did, on average, they imported from at least two of the five countries. The majority of firms,

Figure 9.7 Trading Partners Using Multiple Responses (N = 59)



PRC = People's Republic of China, Lao PDR = Lao People's Democratic Republic,
N = number of respondents.

Source: Results of ADBI-funded survey in 2004.

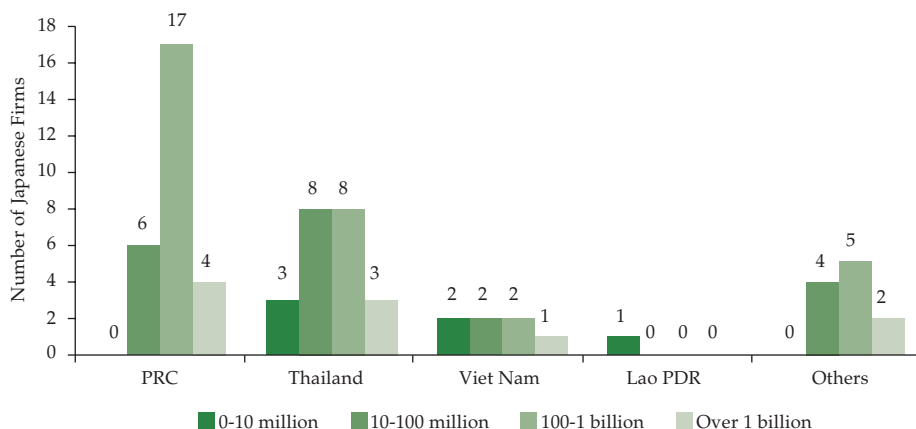
⁸ Please refer to Table A4.2 of Appendix 4 for the breakdown of agricultural products imported by Japanese firms.

78% or 36 of the total firms, imported food from the PRC. Thailand has the second largest share with 27 firms or 57.6%, followed by Viet Nam with 9 firms at 20.3% of the total. Only one firm reported importing green products from the Lao PDR and none reported trading with Cambodia.

The respondents were asked to provide information on the amount of imports for the most recent year. The majority (32 firms) reported importing between 100 million yen and 1 billion yen in 2004, more than half of which were from the PRC (Figure 9.8).

As for the varieties of imported products, respondents were asked to enumerate the top three items imported by country. The results show that corresponding to scope of activity in the countries, the largest range of products is from the PRC with 115 types of products, followed by Thailand with 70 types, and Viet Nam with 14 types (Table 9.1).

Figure 9.8 Distribution of Surveyed Firms* by Import Value, 2004



PRC = People's Republic of China, Lao PDR = Lao People's Democratic Republic.

* Cambodia is excluded as none of the firms in the study traded with the country at the time of survey.

Source: Results of ADBI-funded survey in 2004.

Table 9.1 Number of Imported Items by Country Using Multiple Responses

	PRC	Thailand	Viet Nam	Lao PDR	Cambodia
Total no. of items	115	70	14	1	0
No. of respondents	46	34	12	1	0

PRC = People's Republic of China, Lao PDR = Lao People's Democratic Republic.

Source: Results of ADBI-funded survey in 2004.

Specific products seem to be imported from each country. From the PRC, mushrooms were the top import. Of the 46 firms, 8 imported shiitake mushroom, a popular ingredient in Japanese cuisine. From Thailand, asparagus topped the list with 11 firms involved in its importation. Viet Nam was the major supplier of imported spinach and said to be fast catching up. Only vegetables had so far been imported from the Lao PDR.⁹

With the exception of Thailand where there is a high proportion of fresh produce, the majority of the food products were reportedly imported in fully processed form. The highest percentage of processed produce was from Viet Nam, at nearly 36%; while Thailand and the PRC had a roughly similar proportion at 30%.¹⁰

9.5.3 Institutional Arrangement for Sourcing Supply

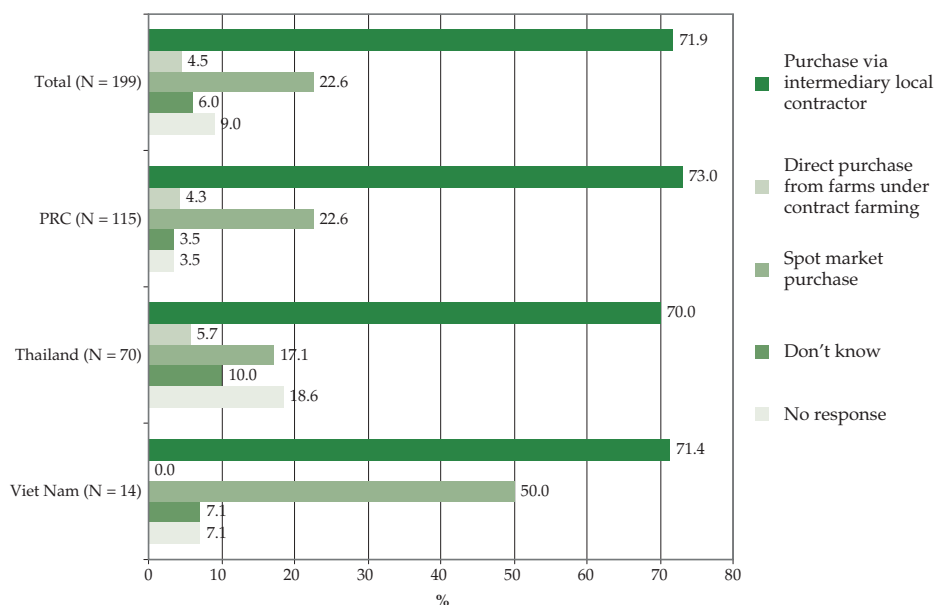
When asked to identify source of suppliers for each of their major imported product, the survey shows that, for all the countries, over 75% of imported items originated from contracted farms organized through their local intermediaries. Interestingly, 4.3% and 5.7% of imported products from the PRC and Thailand, respectively, were sourced from direct contract farming operations by the Japanese firms themselves. Follow-up interviews revealed that in the case where new and high-value products were produced and where the legal environment allowed for firms to operate directly in the countries, Japanese firms would be directly involved in supervising the production. However, once the technology is transferred and product quality is assured, the production operation under contract farming is taken over by their local intermediaries.

In the case of Viet Nam, a bigger proportion of the imported items seemed to have been sourced simultaneously from the spot market and contract farming (Figure 9.9). In Thailand and the PRC where contract farming is relatively developed, based on what is demanded in the Japanese market, firms would identify the appropriate supply source in these two countries. In Viet Nam, since contract farming is still evolving, choice of crops for sourcing was limited.

⁹ Please see Figure A5.2 of Appendix 5 for more information on the degree of processing of imported agricultural products by country.

¹⁰ Please refer to Figure A5.3 of Appendix 5 for detailed information on the type of traceability and organic certification employed by Japanese firms in each country.

Figure 9.9 Source of Supply



PRC = People's Republic of China, N = number of imported items.

Notes:

1. As none of the countries imported products from Cambodia, it is excluded from the chart.
2. Only one firm directly purchased from farms under contract in the Lao People's Democratic Republic.

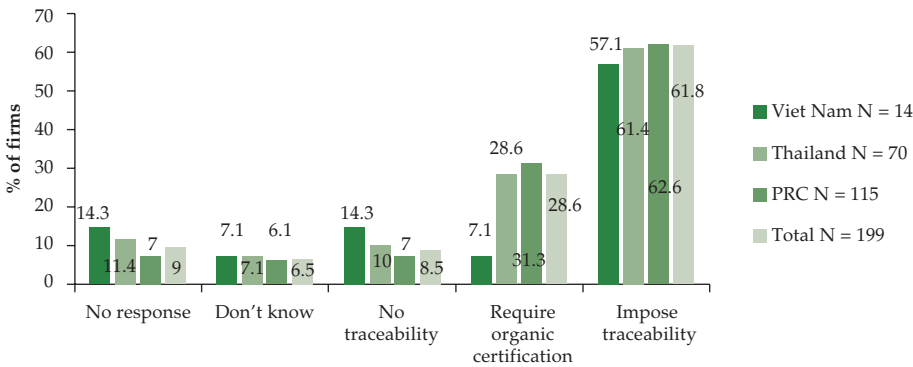
Source: Results of ADBI-funded survey in 2004.

It was pointed out in interviews that contract farming arrangements in the PRC have been instrumental in upgrading the capacity of local farmers to produce export-quality green products that meet Japanese standards. One large joint-venture company in the survey established a system called the Sustainable Production System, also known as the *meister system*. In this system, Japanese experts train leaders of local farmers to carry out production procedures and quality inspections. A Japanese company that has been doing business in the PRC for over 15 years established the *meister system* in early 2000 and has since been operating profitably.

9.5.4 Traceability and Certification

More than two-thirds of the imports from the PRC and Thailand were subjected to traceability, compared to only 57% of imports from Viet Nam. Figure 9.10 provides more detailed information on the kind of traceability and organic certification required by the firms.

Figure 9.10 Traceability and Certification



PRC = People's Republic of China, N = number of imported items.

Notes:

1. Cambodia is excluded as none of the firms in the survey imports from the country.
2. One firm imports from the Lao People's Democratic Republic and uses organic certification.

Source: Results of ADBI-funded survey in 2004.

As shown in Table 9.1, more than half of the firms that imported from the PRC and Thailand indicated requiring a detailed report of all inputs throughout the production process to ensure traceability. In the case of organic certification, major companies require local producers to comply with strict international standards, such as JAS, Eurogram, and the Food Alliance Certificate System. Domestic certification is often insufficient, even when available and accredited by local authorities.¹¹

On mechanisms to ensure compliance, for the PRC and Thailand, more than half of the firms reportedly used third-party inspection.¹² Another method used was random sampling of products to test for chemical residues in Japan. The survey showed that firms providing direct guidance and conducting inspection at the farm level were more prevalent in the Lao PDR and Viet Nam. Presumably, this is because the business ventures are relatively new and capacities to inspect and certify products are less developed compared to the PRC and Thailand.

¹¹ Third-party certification provides product or production claim verification that is not directly tied to the firm or organization producing the product. Securing a third-party certifier to test and place their label or stamp of approval on a product is a way to obtain consumer credibility quickly. Traditionally, government inspectors served as independent third-party inspectors (Tronstad et al. 2005).

¹² Please refer to Figure A5.4 of Appendix 5 for detailed information on the method used to ensure and verify traceability and certification.

With a limited volume and limited kinds of produce imported from Cambodia and the Lao PDR, the imposition of traceability and certification is understandably limited. The lone Japanese firm that imported from the Lao PDR reported relying solely on organic certification while close to 60% of the firms importing from Viet Nam did not respond to this question.

9.5.5 Satisfaction with Imports and Trading Environment

Firms were asked to qualitatively rate their satisfaction (from *very satisfied* to *dissatisfied*) on various investment factors in the five countries. It is noted that firms at the time of the survey did not import from some countries also answered this section, possibly to reflect past involvement or future expansion. Table 9.2 lists the factors that firms evaluated and their corresponding ratings by country as a percentage.

Table 9.2 Factors Assessed and Satisfaction Ratings of Japanese Companies (%)

Factors Assessed	Very Satisfied			Satisfied			Neutral			Dissatisfied		
	PRC	THA	VIE	PRC	THA	VIE	PRC	THA	VIE	PRC	THA	VIE
Growth environment	1.7	5.1	0	23.7	27.1	6.8	35.6	20.3	15.3	11.9	8.5	6.8
Price	10.2	5.1	0	22	11.9	3.4	23.7	27.1	17	17	17	6.8
Labor management	3.4	6.8	0	15.3	11.9	1.7	33.9	37.3	18.6	15.3	5.1	8.5
Steadiness of supply	1.7	6.8	0	27.1	13.6	3.4	30.5	30.5	15.3	17	10.2	8.5
Product quality	0	3.4	0	20.3	15.3	1.7	27.1	30.5	15.3	25.4	8.5	10.2
Transportation facilities	0	5.1	0	20.3	11.9	0	35.6	33.9	15.3	17	8.5	11.9
Maintenance, storage, and processing	1.7	6.9	0	22	13.6	0	33.9	28.8	15.3	11.9	10.2	11.9
Legal procedures	0	1.7	0	11.9	11.9	0	40	32.2	22	18.7	8.5	6.8
Government policy	0	1.7	0	10.2	11.9	0	42.4	40	22.3	17	6.8	8.5
Overall satisfaction	0	1.7	0	18.7	17	5.1	35.6	25.4	11.9	10.2	6.8	6.8
Others	0	0	0	0	0	0	1.7	3.4	1.7	0	0	0

PRC = People's Republic China, THA = Thailand, VIE = Viet Nam.

Note: Cambodia and the Lao People's Democratic Republic are excluded as very few Japanese firms do business in these countries.

Source: Results of ADBI-funded survey in 2004.

In interpreting the results presented in Table 9.2, it is important to note that the total number of responses is different by row as many firms left some of the questions blank. It also appears that a majority of the firms marked *neutral* as their answer, partly due to sensitivity concerns of making public their views about the countries in the survey.

Based on the results of survey, the PRC and Thailand were given higher satisfaction ratings than the other three countries at the time of the survey in 2005. As Japanese investment in Thailand is relatively well established relative to Cambodia, the Lao PDR, and Viet Nam, this outcome is not surprising. In the case of the PRC, however, considering the relatively short period of investment experience, the high satisfaction rating may be due in part to climatic conditions and geographical proximity. Nevertheless, it may be an indication of confidence in institutions in the PRC, successfully facilitating Japanese investments in the country. Of the firms importing from the PRC, 10% were greatly satisfied with the affordability of produce (price), 30% were satisfied with predictability and steadiness of supply, and about 15% were dissatisfied with labor management.

A majority of the firms gave a neutral rating on overall performance for the PRC, about 36% (15 firms) of the total 51 firms. None of the firms were *very satisfied*, with only one firm *very dissatisfied* about doing agribusiness in the PRC. Of the firms, 19% (10 firms) were generally *satisfied*, with almost a third of the respondents declining to give their valuations.

In the case of Thailand, a quarter of the firms (10 firms) gave a neutral overall rating. About two firms gave a very satisfactory rating on labor management, growth environment, processing equipment, and transportation facilities. With regard to product quality, although the majority of the respondents were neutral on this attribute, the proportion of satisfied respondents was significantly larger than that of the dissatisfied ones. Unlike the PRC, Thailand did not elicit any very dissatisfactory rating, although almost half of the sampled Japanese firms declined to give their valuation.

For Viet Nam, none of the 21 firms doing business there gave a very satisfactory or very dissatisfactory rating. Almost three-quarters declined to give their valuation, with the remaining quarter either *neutral* or *slightly dissatisfied* with the overall situation. More specifically, respondents were dissatisfied with transport infrastructure, processing and storage equipment, and product quality.

At the time of survey, of the other two countries, only one firm did business with the Lao PDR and none with Cambodia. Nonetheless, some firms gave their valuations on the two countries. Firms generally do not have a positive perception of either country, which could be partly explained by their lack of knowledge on them. Overall dissatisfaction pervaded on both country ratings that substantially explains the minimal business engagement of Japanese firms in this sector. Japanese firms expressed similar concerns to those they face in Viet Nam, i.e., transport infrastructure, state of equipment, and product quality, which all received low ratings. In the case of Cambodia, legal requirements and export procedures were also perceived to be problematic.

9.5.6 Future Import Prospects

On future plans, 44% and 34% of respondents expressed an interest in expanding imports from the PRC and Thailand, respectively. Of the respondents, 40% planned to keep imports at current levels in the PRC and 22% in Thailand. A 24% of the firms expressed interest in increasing imports from Viet Nam and two-thirds of the respondents gave no response.

The following products were identified for possible import expansion:

- PRC: vegetables, such as cabbage, carrot, yam, taro, and green soybeans
- Thailand: mango and other fruits; vegetables, such as asparagus and eggplant
- Viet Nam: onion, ginger, and rice

With regard to future prospects for green imports from Cambodia and the Lao PDR, only 8.5% expressed an interest in importing from either country. Only one firm reported conducting a feasibility study on importing green and organic products from the Lao PDR. Importing coffee from the Lao PDR was also another possibility. Some firms have imported coffee from Viet Nam, but a number have expressed dissatisfaction with quality control and have explored the Lao PDR and Timor-Leste as alternatives at the time of survey. Some Japanese coffee-trading companies viewed the Lao PDR as a potential source of new coffee flavors based on wild and local coffee beans that had not been marketed before. During the face-to-face meetings, respondents emphasized the need for stricter quality control. As there was no inspection institute in the Lao PDR at the time of survey, quality assurance was a barrier for coffee producers in the country.

In general, the respondents reported knowing very little about Cambodia and the Lao PDR, particularly with regard to agricultural production systems and capacities, quality attestation standards, reliability of local trading partners, mechanisms for contract enforcement and dispute settlement, and political and economic risks that could disrupt trade and investment.

By and large, however, the decision to import from Cambodia and the Lao PDR seems to rest heavily on the traceability and certification of their products. One firm decided against importing from the Lao PDR due to the unreliability of systems that ensure product quality and consistency. Moreover, despite the fact that subsistence farming and low external inputs agriculture still prevail in Cambodia and the Lao PDR, neither country seems to have a solid reputation of being a reliable producer of green products. There seems to be a misconception among Japanese firms that agricultural systems in both countries rely heavily on chemical fertilizers and pesticides, and that the use of those agrochemicals is not regulated by the government. While importing Japanese firms are not keen to engage in contract farming in Cambodia and the Lao PDR, they encourage their counterpart firms in Thailand to expand their contract farming operations to these countries.

9.5.7 Technical Support Provision

Firms operating in the PRC seemed to be the most willing to provide more technical support (Table 9.3). Some firms expressed willingness to provide technical support to producers in the PRC, Thailand, and Viet Nam

Table 9.3 Possible Areas for Technical Support

Type of Technical Support	PRC	Thailand	Viet Nam
Production Management			
Cultivation technology	√	√	√
Product processing	√		
Establish comprehensive production management system	√		
Traceability			
Introduce book entry system	√		
Conduct inspection technique courses	√	√	√
Dispatch inspection technique specialist	√	√	√

PRC = People’s Republic of China.
Source: Author’s summary.

in the areas of production management and traceability. Only one firm expressed willingness to provide technical support to the Lao PDR and none to Cambodia. Assistance for cultivation and inspection techniques are commonly cited areas in need of technical support in all countries. Some respondents have a passive policy, providing technical support only if requested.

9.5.8 Measures to Improve the Competitiveness of Green Products

The majority of the respondents highlighted the traceability requirement of consumers. Recently, the Japanese government has introduced the requirement for products in restaurants to display place of origin; thus, importers will likely stick to current suppliers with a good track record, making market penetration more difficult for newcomers. Apart from food safety and quality, exporters must also demonstrate their ability to provide a steady supply of the bulk of green products. Firms view contract farming as a way to address these concerns, as it allows Japanese firms direct supervision of production and the handling process.

The respondents likewise put forward the following suggestions for producers in developing countries and their respective governments, for the Japanese government, as well as for regional bodies:

- The need to improve production capacity and product information especially with regard to producers and the production process. This includes a reliable production system and accurate documentation of production history. The possibility of setting up regional organizations to plan and carry out production control should be explored. For countries in the Greater Mekong Subregion (GMS) in particular, one firm pointed out that since GMS countries are relatively small, a joint investment for regional infrastructure, such as a regional laboratory to test quality of products, could be set up for the region.
- Firms requested governments of developing countries to conduct research on the Japanese market on demand and requirements for green products, and to disseminate the information strategically to producers. In particular, there is a need to increase consciousness among producers regarding food safety and traceability. Requisite institutions, standards, and procedures for quality attestation must also be established or strengthened, including reliable quarantine and inspection systems, and organic standards and certification bodies. Compliance with free trade agreements must also be ensured. Support for grassroots activities by NGOs could be provided to complement activities of local authorities in rural areas.

- For the Japanese government, assistance to developing country exporters should be provided to improve their competitiveness, especially on compliance with free trade agreements and Japanese regulatory standards. A greater understanding of the JAS Law and requirement for a food traceability system is required. A number of firms also pointed out that the Japanese government could review existing regulations to determine whether some of these are too excessive for developing countries.
- For regional bodies, they should assist in harmonizing standards and procedures which tend to vary widely from country to country.

9.6 CONCLUSIONS

The growing market for green products in developed countries represents one of the most promising opportunities for private sector involvement in reducing poverty and facilitating environmental protection and restoration in developing countries. Through the arrangement of various forms of green contract farming, this business model is contributing to changing the traditional perception of private sector development as largely contributing to worsening of income distribution and to environmental degradation. The main challenge is, however, that market entry is marked by stringent quality and certification standards that producers in developing countries may have trouble complying with. Moreover, several international certifying bodies with their corresponding standards, such as Good Agricultural Practices (GAP), Good Manufacturing Practice (GMP), HACCP, SPS measures, and ISO standards, pose as effective trade barriers to exporters. Once these certifications can be obtained along with improvement of supply chain management, however, the private sector can play a significantly larger role in generating pro-poor growth in rural areas of developing countries.

The findings of this study show that there are significant differences among Asian developing countries in their potential to export green products to Japan. The PRC and Thailand clearly are more advanced in terms of developing national standards and implementing measures to meet market requirements for traceability and certification. Both countries have also been more successful in facilitating firms to adopt contract farming as a way of promoting the export of nontraditional high-value crops, including green products.

Contract farming arrangements by Japanese firms in the PRC and Thailand represent cases where development of the agricultural extension system, food traceability system, and training of local experts are financed almost

entirely by the private sector. The sociopolitical conditions in the PRC and Thailand favoring contract farming have been a product of decades of fine-tuning. While Cambodia, the Lao PDR, and Viet Nam are catching up rapidly, at the time of the survey, the perceptions of the firms showed that these countries are not their prime destinations.

The results of the survey reveal limited enthusiasm from Japanese firms to provide technical training and support, although some firms effectively involved public research and extension systems to address the training needs for the production. Arguably, research and extension are an area where public sector support is essential, and it is one of the areas where a closer partnership between the public and private sectors should be prioritized. Joint research through regional cooperation among countries sharing similar agroecosystems should also be encouraged.

Since green export is a pro-poor development strategy, it would be in the interest of developing countries to make the most out of regional or subregional initiatives to further build capacities in green exports. Given the challenges facing green exports from developing Asian countries, and the amount of effort and investment required to address these challenges, it makes sense for countries in the region to work together and capitalize on each other's strengths to overcome common vulnerabilities. Beyond joint sharing of best practices in private and public partnerships and joint research on common issues, regional forums could provide a venue to address lower certification costs through the following initiatives (i) develop local standards that are harmonized with international standards for traceability and certification, (ii) share best practices in inspections and provision of technical support to producers, and (iii) pool resources for the establishment of reliable third-party inspection institutions in the region. This is because the competitiveness of developing country exports will depend largely on the extent to which they are able to meet international food safety and quality standards including SPS measures and integration into the global food supply chain management that is increasingly becoming vertically integrated.

The results of the survey reveal that contract farming can be a promising institutional arrangement for addressing these issues. The majority of the survey respondents were already utilizing contract farming to purchase core products from reliable local suppliers. These firms require intensive and systematic quality control and traceability. Some firms even check soil maintenance practices, seed growth, and the use of organic fertilizers produced by in-house recycling systems. These firms also closely monitor the

utilization of acceptable chemicals. When necessary, almost all production materials, including daily bookkeeping of production history, are supplied by or via its affiliate companies, with strict requirements for traceability.

Summarized hereafter are the factors that greatly affect the success of contract farming.

9.6.1 Choice of Crop and Effective Management

Contract farming is not appropriate for all crops. The higher level of management associated with managing a new crop makes contract farming feasible for largely high-value crops with strong demand in the destined markets. As illustrated in the Philippine experience, although low labor costs initially attracted Japanese firms to invest in vegetable production there, the inadequate know-how in managing Japanese varieties lowered actual yields. Thus, the costly production resulted in the withdrawal of the majority of Japanese investments to countries with more agroecologically suitable areas.

In Viet Nam, JETRO pointed out that low-quality seeds were widely used and grown by some state-owned firms. The produce was of poor quality and thus could not be exported to Japan. Although the Japanese mission experts recommended the introduction of new varieties of seeds, managers at some state-owned firms were unreceptive to the suggestion. Firms in the PRC by contrast were more responsive to markets. With supportive central and local governments providing basic research on meteorological and soil conditions suitable for selected crops, including forming centers of production to meet the volume for export markets, firms in the PRC were in a better position to address the demand of the Japanese market.

In the case studies, good crop management was found in the PRC, Thailand, and the private sector in Viet Nam. The converse was found in the Philippines and the public sector in Viet Nam, where serious management problems were reported. The PRC and Thailand were identified as more responsive to market specifications and changing consumer preference. PRC firms also proactively gathered information on foreign markets to update themselves on changes in consumer preferences.

9.6.2 Contract Enforcement

Contract enforcement is a general problem in firms operating cross-border contract farming. The JETRO studies identified extra-contractual

sales, redirections of inputs, cash advances, and outputs as common problems in contract farming, particularly in the Philippines and Viet Nam. Furthermore, the firm survey showed that firms stressed the importance of moving toward the establishment of formal laws and an efficient legal system to enforce contract rules. Along with establishing a legal framework to facilitate formal contract enforcement, alternative mediating or extrajudicial bodies can be used to reduce contract breaches. In some cases, semiformal conflict resolution can be organized by the parties involved, i.e., local governments, farmers' organizations, and joint bodies between communities and firms to address contract enforcement.

9.6.3 Supportive Governmental Program and Policies

In the case of the central and some local governments in the PRC and Thailand, among the success factors identified by the surveys were the well-developed transport infrastructure that facilitated investment in rural areas. In addition to the hard infrastructure, these two countries encouraged foreign direct investments through exemptions from tax and customs duties, and improved efficiency of custom procedures, among others. Viet Nam has since improved in these aspects and is emerging as a competitive destination for investment.

9.6.4 Compliance with International Standards and Practices

With increased concerns in food safety and more stringent international trade rules, including the SPS measures, entry to the more lucrative export markets is only feasible when standards are met and certifications are obtained. Countries that proactively address these issues can improve their competitive edge over others. In the case of organic food trade, which directly addresses rural poverty reduction, the PRC and Thailand are examples of countries that successfully facilitated farmers' entry to more lucrative export markets through support of proper certifications and traceability systems. Led by the private sector and NGOs currently operating in limited areas in remote regions of these two countries, the public sector could assist to scale up organic agriculture by lowering the costs of certification. This could be done through activities such as establishing a legal and regulatory framework on certified organic products, harmonizing organic standards among trading partners, as well as providing capacity building for implementing an organic certification system.

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APPENDIXES

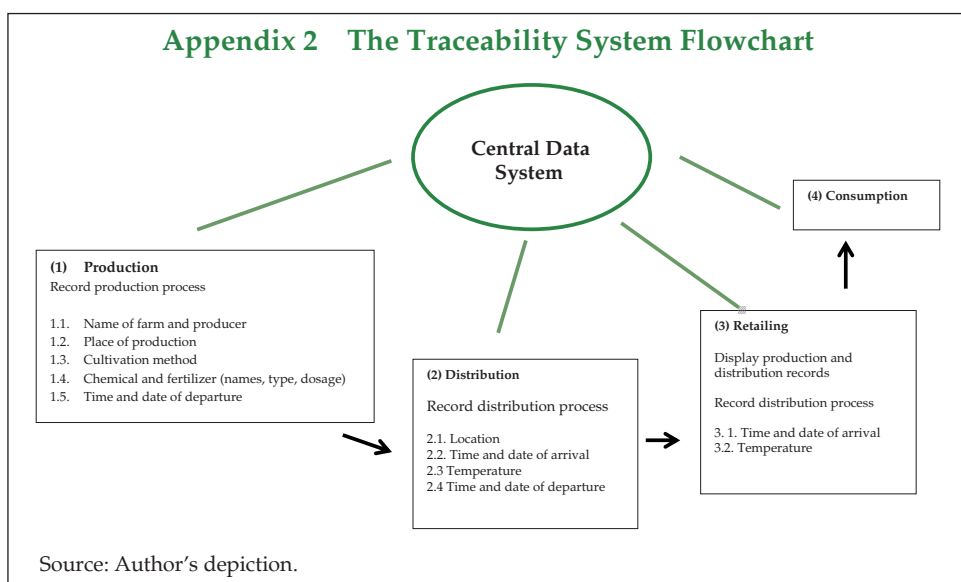
Appendix 1 Definition and Flowchart of Traceability System

“Traceability” is defined by the Codex Alimentarius Commission as “the ability to follow the movement of a food through specified stage(s) of production, processing and distribution.” The International Standards Organization (ISO 9000/2000) defines it as the “ability to trace the history, application or location of an entity for consideration.” In general, traceability systems have three main functions (Hobbs 2003):

- 1) facilitate the trace back of products or animals in the event of a food safety problem;
- 2) enhance the effectiveness of tort liability law as an incentive for firms to produce safe food; and
- 3) reduce information costs for consumers by providing prepurchase quality verification through labeling.

The basic idea of the food traceability systems is seen in Appendix 2. Record keeping starts with the producer, to reflect information on the name of the farm and producer, the place of production, the type of cultivation method the name, type, dosage of any chemicals or fertilizers used in production, and the time and date of delivery to the distributor. The producer’s records are handed over to the distributors, who in

Appendix 2 The Traceability System Flowchart



turn log the distribution processes, and so on down the line. Ideally, the cumulative records of product history should be passed on to the downstream counterparts (green arrows in the figure), but in reality it is possible that not all of the information is transmitted in this manner. Therefore, persons in the downstream, such as retailers and consumers, are sometimes unable to obtain the necessary information.




In order to overcome this problem, modern traceability systems have been developed with the aid of information technology. With such traceability systems, records no longer have to be handed over to the immediate downstream counterpart (e.g., from producers to distributors); instead, the information can be stored in the central data system (red lines in the figure). So long as the original information is stored in the central data system, the downstream counterparts need not maintain cumulative records, and the downstream counterparts can always check the information generated in the upstream processes.

Appendix 3 Developments in Traceability Technology

Table A3 provides a comparison of the most common types of media currently used for transmitting the data compiled and stored in the traceability system. Each of these media has its own technical limitations and economic costs vis-à-vis the product being traced. Consequently, agribusiness firms considering the implementation of a traceability system should select the type of media most suited for their needs. For example, it will be possible to secure traceability even by using handwritten logs as media and storing these documents. There will also be cases where it would be more effective to adopt a mechanism capable of using two or more media types or to establish a joint-use database center for data management.

- (i) Log/record book: Logs or record books are the simplest way of establishing a traceability system. Data are entered in sheets of paper (e.g., forms), log books, or the computer to store the information.
- (ii) Bar codes: Bar codes have become a fairly common media for exchanging information. The traceability system with bar codes has the following features: (a) it has high scanning efficiency; (b) scanning is possible without touching the product; and (c) it is inexpensive because the essential material is a paper label.
- (iii) Two-dimensional bar codes: Two-dimensional bar codes consist of black and white dots and lines combined vertically and horizontally (see Table C). Because information is recorded both vertically and horizontally, two-dimensional bar codes can contain more information

Table A3.1 Comparison of Traceability Devices

	Log/record book	Barcodes/ Serial numbers	2-dimensional barcodes	IC chips/ID tags
				
Data storage capacity	size of notebook	20 characters	Max. 7,089 characters	Max. 7,089 characters (2k byte memory)
Information processing/ Retrieval	Slow	Quick	Quick	Quick
Multiple-read	No	No	No	Yes
Rewritable	Yes	No	No	Yes (rewritable chips)
Reusable	No	No	No	Yes
Material Costs (current)	cost of notebook	1 yen or less	5 yen or less	20 to a few hundred yen
(near future)	cost of notebook	1 yen or less	5 yen or less	1 to 5 yen
Copy protection/ Authentication	No/No	No/Yes	No/Yes	Yes/Yes

IC = integrated circuit, ID = identification.

Source: CGIFTS (2003).

than a conventional bar code. One shortcoming, however, is that the reader is more expensive than a conventional reader.

- (iv) Integrated circuit (IC) chips or ID tags: IC tags use radio frequency identification (RFID) technology to transmit the information. The tag is made up of a tiny IC chip and an antenna for wireless communication. Although the IC chip itself is no larger than a sesame seed, it can store a far larger amount of data than the conventional bar code. Data on the chip can be rewritten or added to, and while bar codes can only be read one at a time, IC tags can be read simultaneously at a rate of 50 per second (Web Japan 2003).

IC tags are still expensive compared to more conventional alternatives, although developers and manufacturers expect that the cost of an IC tag should decline to less than 10 yen within the next 3–4 years, due to economies of scale in manufacturing.

Figure A3.1 shows the information in a typical documentation for traceability systems. This information may be available in electronic and/or paper form, depending on requirements of buyers. In this system, the producer or farmer can be easily traced by buyers or end-consumers should any concern arise regarding safety and quality of produce. This system facilitates feedback which can significantly affect vegetable purchases of both wholesalers, such as agrifood firms, and retailers, such as supermarkets. Farmers can build credibility in this system which can greatly affect future business.

Figure A3.1 Examples of Documentation for Traceability System

私の主張

地場野菜は、新鮮なのでおいしいです。

My Motto:
Profile:

生産者のプロフィール



生産者	井出農園	Name of farm
代表者氏名	井出 茂雄	Name of producer
住所	神奈川県藤沢市	Address
電話番号	000-XXXX-XXXX	Phone
Eメールアドレス	OC@apl.hi-hi.ne.jp	Mail address
ホームページ		Homepage

Greetings from producer

私のこだわり野菜作り

野菜(野菜、牛蒡、茄子)をバリエーション使い、野菜が上手に実を収穫出来るようにしています。また、同じ土壌で同じ作物は作らず、順番に栽培作物を変えています。土の栄養が偏らないように工夫しています。新鮮でおいしい野菜を食べてもらうため、心き込めて作っています。

(including own policy in vegetable production)

栽培情報



Information on cultivation & product

生産者名	井出農園	Name of farm (producer)
生産地	神奈川県藤沢市	Place of Production
栽培方法	露地栽培	Cultivation Method
肥料	鶏糞、牛糞、緑肥を使う有機肥料を使用	Fertilizer applied
農薬	スピノサース顆粒水和剤、アデマイヤー12アズール、オースム乳剤、ラベックスアブゾルなどを使用	Chemical Applied

品名	キャベツ	Name of produce
品種	しずはま2号	Variety

栽培・運送映像 (約60秒)



栽培風景を
30秒で見る。
動画をクリック

外見の特徴	みずみずしく、新鮮です。
味の特徴	歯ざわりがよく、噛むとほんのり甘みがあります。
生産者からのコメント	食味の好きな食べ方 1. サラダにして、ごまドレッシングやマヨネーズをかける 2. 野菜炒めにする おいしく栄養価の高いキャベツの芯を、上手に活用して下さい。
産地特性	新鮮なままお届けできます！ 経路はどのにも負けません！温度変化のない冷蔵が味わえ
栽培上のこだわり	消費者の方が食べておいしく思うものを作ること。そして作った作物を、新鮮なうちに食べてもらうこと。この2点にこだわっています。

Source: Author's field study.

Appendix 4 Survey Tables

Table A4.1 Distribution of Survey Instruments by Sector

Type of Industry	Number of Questionnaires Sent	Conduits Used to Pick Up Survey Samples
Food processing industry	160	Association of Japan Food Import Wholesalers Okinawa Brewery Union
Wholesale business	179	Central Wholesale Market Union: Vegetables and fruits sector Japan Food Import Wholesalers Association
Retail business	161	Japan Retailers Association Japan Chain Stores Association
Restaurants and restaurant chain stores	167	Japan Food Service Association Japan Hotel Association
Participants in the investment seminars (including individuals)	75	Attendance lists of the investment seminar and business forum for Cambodia and the Lao People's Democratic Republic organized by the Association of Southeast Asian Nations Center in 2005
Other companies	43	Quarterly company directory
Total	742	

Source: Results of ADBI-funded survey in 2004.

Table A4.2 Major Imported Items by Country

Rank	PRC	Thailand	Viet Nam	Lao PDR
1	Shiitake mushroom (8)*	Asparagus (11)	Spinach (2)	Vegetables (1)
2	Broccoli (6)	Okra (8)	–	–
3	Bamboo shoot (5)	Mango (6)	–	–
O t h e r s (1)	Rice	Rice	Sesame	–
	Matsutake mushroom,	Soybeans	Burdock	
	Onion	Ginger	Rice	
	Ginger	Sweet corn	Processed foods,	
	Radish	Eggplant	such as cucumbers	
	Taro	Processed foods, such	preserved in salt,	
	Processed foods, such as	as canned pineapples,	frozen spinach and	
	bamboo shoot preserved	frozen green soybeans,	frozen cucumbers,	
	in water, frozen taro and	pumpkin paste,	pineapple,	
	welsh onion, canned	plant oil,	saccharide,	
	orange and apple	mangosteen, etc.	cattle feed, etc.	
	juice, etc.			

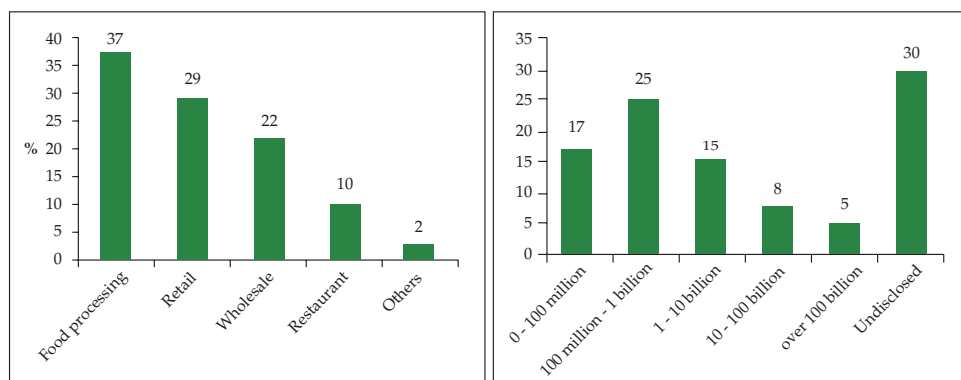
– = none reported, PRC = People's Republic of China, Lao PDR = Lao People's Democratic Republic.

* Figures in parentheses denote the number of Japanese firm trading with the country for a particular produce.

Note: As none of the firms import from Cambodia, the country is excluded from the table.

Source: Results of ADBI-funded survey in 2004.

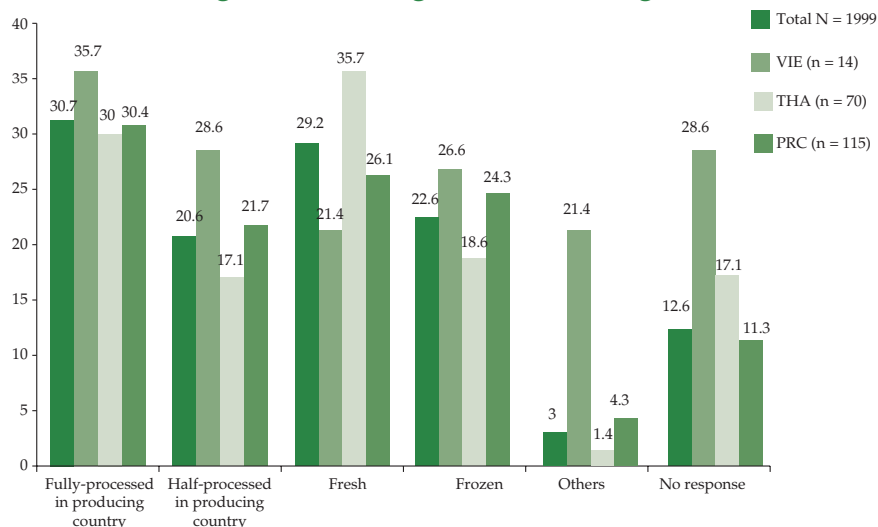
Appendix 5 Survey Figures

Figure A5.1 Distribution of Respondents by Industry (N = 59) and by Capital Size (JPY)

JPY = Japanese yen, N = total number of respondent firms.

Source: Results of ADBI-funded survey in 2004.

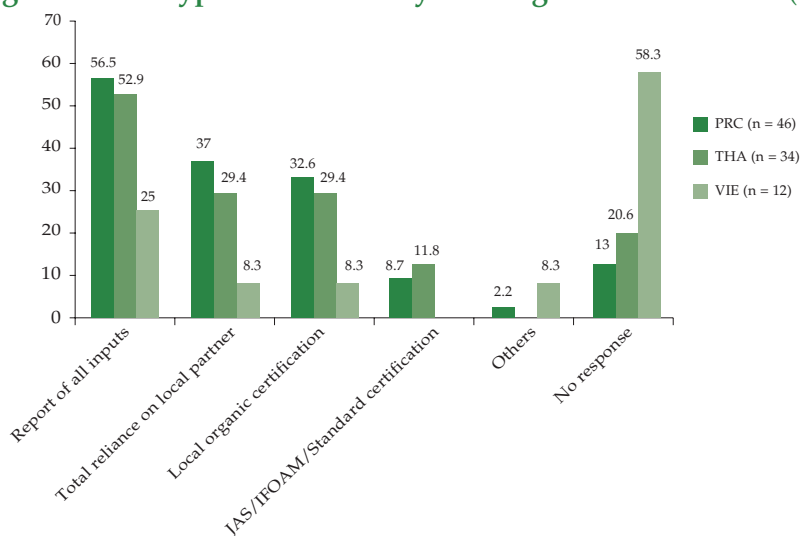
Figure A5.2 Degree of Processing (%)



PRC = People's Republic of China, N = total number of imported items, n = number of imported items from a country, THA = Thailand, VIE = Viet Nam.

Source: Results of ADBI-funded survey in 2004.

Figure A5.3 Type of Traceability and Organic Certification (%)

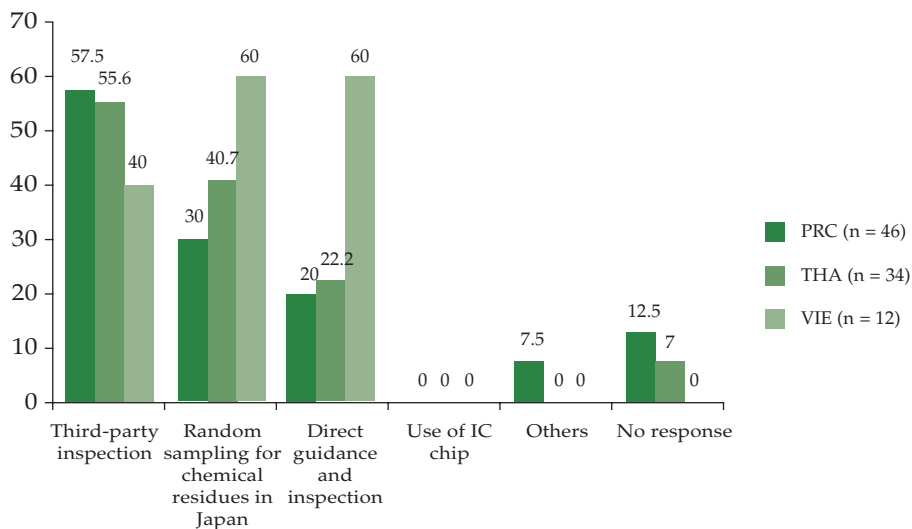


PRC = People's Republic of China, IFOAM = International Federation of Organic Agriculture Movements, JAS = Japanese Agricultural Standards, n = number of imported items from a country, THA = Thailand, VIE = Viet Nam.

Note: The Lao People's Democratic Republic had one firm that used local organic certification at the time of survey.

Source: Results of ADBI-funded survey in 2004.

Figure A5.4 Method of Ensuring/Verifying Traceability and Certification (%)



PRC = People’s Republic of China, IC = integrated circuit, n = number of imported items from a country, THA = Thailand, VIE = Viet Nam.

Note: As none of the firms import from Cambodia and imports were unprocessed from the Lao People’s Democratic Republic, both were excluded.

Source: Results of ADBI-funded survey in 2004.

PART IV

Evolving Forms of Contract Farming Practices

10. Is a Written or Verbal Contract Better for Farmers? Case Study of Asparagus Contract Farming in Thailand

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10.1 INTRODUCTION

Supporting smallholder farmers to improve income through diversifying into high-value crops for the market is an important poverty reduction strategy adopted by developing countries. In addition to the need to provide smallholder farmers with inputs, techniques, and a market for products, improved food safety, proper use of agrochemicals, and health impacts on farmers and producers have become an added concern for governments. In consideration of these issues, contract farming has been increasingly adopted as an institution to facilitate participation of smallholder farmers in urban and export markets. As contract farming evolves, the general advantages and disadvantages of contract farming have become well understood, but there is less consensus on its pro-poor features.

In promoting contract farming as a development tool, many development experts view the written form of contract farming as superior in terms of efficiency—which should be promoted to achieve greater development impacts, particularly for small and less experienced farmers in competitive markets—as written contracts stipulate access to inputs and markets, and predetermined prices for produce (Sáenz-Segura 2006; Castella, Saridnirun, and Trebuil 1995). Banks generally accept written contracts as collateral for loans. Most farmers see this benefit as a strong incentive to engage in (written) contract farming (Glover and Ghee 1992). Moreover, written contracts lead to fewer disputes between parties, compared to the informal or verbal form of contract farming. Many governments and donor agencies in developing countries took this view and attempted to promote and expand written contract farming to benefit poor populations. However, as rural areas of developing countries have a less developed legal system, results of contract farming have been mixed. No study to date has investigated this issue in detail. In particular, no empirical study has been done to assess the benefits of written and verbal contracts for the farmers. Using a unique dataset, complemented by field visits, from an area where both written and verbal asparagus contract farming coexist in

Thailand, this chapter reviews the differential contractual arrangements for smallholder farmers and investigates empirically their implications to production systems and benefits to farmers.

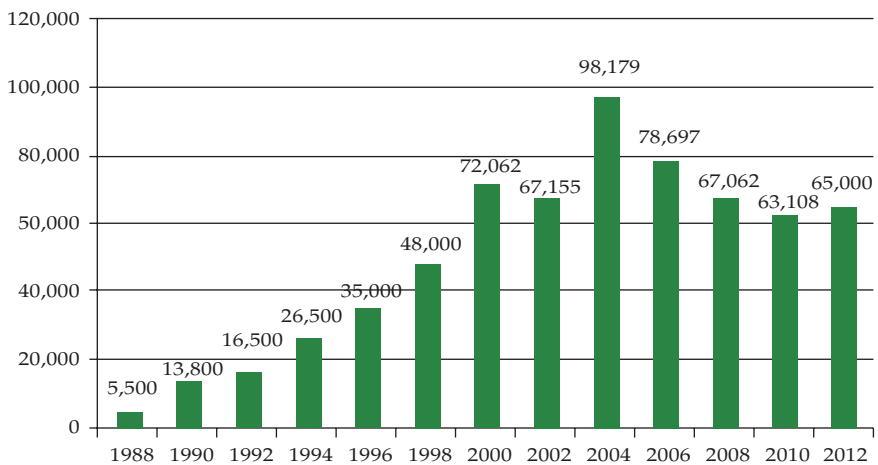
10.2 THE ASPARAGUS BUSINESS IN THAILAND

Asparagus is one of the high-value crops promoted in different parts of Asia with various levels of success. In Thailand, growing green asparagus for export has been promoted since the late 1980s and has become an important cash crop for farmers owing to its higher return per rai¹ compared to other crops. The development of commercial asparagus was first introduced experimentally at Kasetsart University in 1956 using the “Mary Washington” variety. Cultivation of asparagus gained some level of popularity after it was reintroduced in Petchburi in 1972 as a royal project. Farmers nearby learned of the techniques and began cultivating asparagus for export. However, asparagus production only took off in the late 1980s when the Ministry of Agriculture and Cooperatives introduced farmers to high-value cash export crops and proclaimed 15 districts as asparagus areas (Manarungsan, Naewbanji, and Rerngjakrabhet 2005).

Asparagus in Thailand was initially grown for the Japanese market. Taniyama Siam Co., Ltd. pioneered contract farming of asparagus for export to Japan in cooperation with the Ministry of Agriculture and Cooperatives in 1987. The Government of Thailand was instrumental in the spread of asparagus production for export, and the crop is now being exported to various markets. In fact, Thai asparagus dominates the market in Taipei, China (Manarungsan, Naewbanji, and Rerngjakrabhet 2005). Major export markets include Australia, Europe, and the United States. Exports have expanded to India and the United Arab Emirates, and until recently to the People’s Republic of China (PRC) (currently the world’s biggest producer of asparagus by volume) to fulfill its export commitments when yields are insufficient. In the first half of 2010, the PRC imported 10 metric tons of green asparagus from Thailand, a decrease of 75% from the previous year mainly due to a 65% increase in price—from \$0.60 per kilogram in 2009 to \$1 per kilogram in 2010 (Scott and Zhang 2010).

The export value of Thailand’s asparagus grew by 40% and export volume expanded by 60% over the 5-year period from 2000 to 2005 (Manarungsan, Naewbanji, and Rerngjakrabhet 2005). Production surged in the late 1980s, from 5,500,000 tons in 1988, toward its peak in 2004 at 98,179,000 tons.

¹ 1 hectare = 6.25 rai.

Figure 10.1 Asparagus Production in Thailand, 1988–2012 ('000 tons)

Source: FAOSTAT Database.

Figure 10.1 shows average production every 2 years, and production was trending downward since its peak in 2004. It remains to be seen if the uptick in 2012 will continue.

10.2.1 Asparagus Production and Contract Farming

Asparagus is a unique horticulture crop that has an average of 7 productive years, and thus, return to investments can be reasonably high. Asparagus production follows a complex process from the preparation of beds to caring of the stems. The crop is usually harvested continuously for 60 days in intervals of 90 days, harvesting usually begins after 1 year of establishing the asparagus field. In general, farmers replant the crop after 5 years but with good care, the crops can be harvested up to 15 years, or even up to 50 years (Sanders 2001).

Asparagus farming is by itself labor-intensive, and more so for farmers growing for export as standard specifications are strict and monitoring for compliance can be overwhelmingly expensive and tedious (Lorlowhakarn, Piyatiratitvorakul, and Cherdshewasart 2008). Owing to the special care required in asparagus production and to sanitary and phytosanitary standards of importing countries, a substantial portion of asparagus supplied is generally grown under contract farming arrangements.

Ever since Thailand's major export market—Japan—revised its standards on pesticides and other residues in 2006, contracting firms imposed more stringent controls on asparagus farmers or shifted to organic production to facilitate compliance with Japanese standards. (Manarungsan, Naewbanji, and Rerngjakrabhet 2005). Japanese agribusiness contractors engage farmers' groups (not individual farmers) with the district agricultural extension officers often serving as witnesses in the contract signing (Muenthaisong and Wongtragoon 2008). Written contracts stipulate the rules of engagement of each party. In cases of contract breach, written contracts have government backing, which could help farmers get a fair deal. The government's support affirmed the importance of contract farming as a rural development strategy and of Japan as a major export market and large-scale investor in asparagus production.

10.2.2 Importance of Farmers' Groups in Asparagus Contract Farming

Asparagus growing requires a high level of labor input. Thus, plots are often small, making it appropriate for farmers with small landholding. To ensure sufficient care for the crops, contracted farms are often limited in plot size: 2 rai per household. Since individual yields of these plots are insufficient to meet the demands of prospective buyers, farmers form groups to pool their yields and achieve the required quantity to enter into a marketing contract.

The farmers' group facilitates contracting with agribusiness companies (Castella, Saridnirun, and Trebuil 1995). Each group has a leader who ensures product quality and uniformity, which saves the group supervision and monitoring costs. The group leader also conducts regular farm audits to ensure proper farm management of group members and penalizes those who breach contracts; they can also mediate among disagreeing members and act as a distributor of the contracting company's prescribed inputs. Farmers' group are expected to keep its farmers committed to fulfill its contractual obligations, particularly to ensure sufficient volume of produce for collection. To maintain and expand membership of a farmers' group, there are monetary and nonmonetary incentives in place.²

First, technical support on the tedious process of growing and harvesting asparagus is often extended by contracting firms to farmers' groups. Members also gain from experienced members and the group leader.

² Information obtained from authors' field visits.

Second, as produce is perishable, immediate transportation to processing centers is required. Delivery is only cost-effective when done in bulk rather than in small volume, which is facilitated by the farmers' group.

Third, market assurance is higher. While there are many seasonal merchants, the few year-round buyers of asparagus prefer to do business only with farmers' group.

Fourth, collective bargaining power is higher in farmers' groups. Larger volumes often obtain higher prices than small quantities. This leverage also allows farmers' groups to choose which among the contracting companies to contract with.

Generally, farmers choose firms according to (i) offered price, (ii) punctuality of payment, (iii) stability of the company, (iv) grading practice, and (v) benefits for the group leaders in exchange for their group management activities (Manarungsan, Naewbanji, and Rerngjakrabhet 2005).

A farmers' group in asparagus production in Thailand is also an organizational system that facilitates compliance with production standards. The contractual arrangement with the exporter or trader is either in the form of a verbal or written contract. Under the arrangement, farmers are generally provided with access to inputs, technical support, and, most importantly, assured markets with predetermined prices as stipulated in the contract. There are cases where contracting companies hire a broker who takes charge of several farmers' groups, monitors their production progress and sorts out technical issues; visits are frequent, usually 3–4 times weekly (Manarungsan, Naewbanji, and Rerngjakrabhet 2005).

10.2.3 Actors in Asparagus Farming

Broadly, the stakeholders in the asparagus business are the farmers and buyers. The buyers can be local collectors, intermediaries serving as conduits for exporting firms, wholesalers, or frozen food factories. Some exporting companies, both local and joint ventures, and agroprocessing firms directly contract farmers to grow asparagus exclusively for them.

The farmers include farmer's groups and their respective leaders, each with corresponding duties to ensure continued production under contract. Member farmers must comply with specifications of the buyer and must transport their produce upon harvest to the designated collection point in the village. The leaders must represent interests of members in contract

negotiations with buyers and serve as information channels from buyers to farmers.

On the buyers' side, the exporting companies are usually the most selective in their choice of farmers' group, choosing only those they deem capable of compliance. The exporting company generally provides technical support to ensure that the production process, grading, packing, and other postharvest handling procedures comply with export requirements. In addition, regular supervision visits are made to ensure proper usage of pesticides and fertilizers in production. If intermediaries are employed, they typically perform pesticide testing on farms before harvest to determine which farms are acceptable suppliers of asparagus (Manarungsan, Naewbanji, and Rerngjakrabhet 2005).

In effect, contract farming as an institutional arrangement has been found to be a viable mechanism in sustaining the trade relationship between producers and buyers, and facilitating the expansion of Thailand's asparagus export.

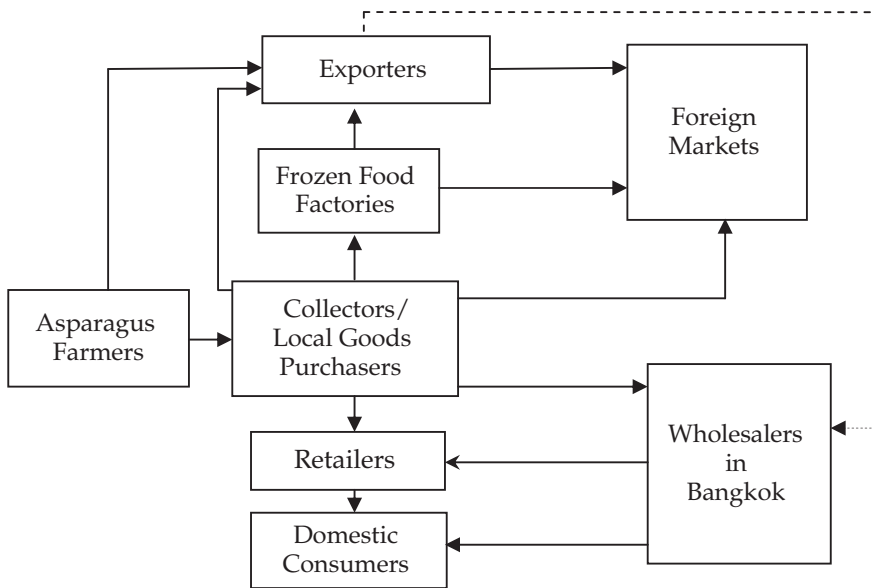
10.2.4 Marketing Network

The distribution channels of asparagus are summarized in Figure 10.2. The flow starts with farmers who take their produce to be graded at the collection site of the farmers' group. Prospective buyers or their representatives come to the site to audit the grading. Purchase takes place at the collection point where the produce of the farmers' group is graded. The asparagus is then distributed to various markets according to grade.

In the case of local collectors, they then resell their asparagus according to grade to exporters, wholesalers, retailers, frozen food factories, restaurants or food shops, and hotels. During "normal" demand season, all export-grade asparagus is exported, leaving almost all off-grade lot for domestic consumption in Thailand. When international demand is low, particularly in Japan or Europe, exporting companies also sell the procured asparagus in the local market. It is during these lean periods when low-, off-grade asparagus is sold at very low prices. This adversely affects independent farmers, i.e., nonmembers of farmers' groups, as their produce can only fetch very low prices if they are able to sell at all.

The purchased quantity varies according to buyer. Most local collectors buy the whole lot or all grades, while some exporters buy only fresh produce of certain grades. The grading process, including the person

Figure 10.2 Asparagus Distribution Channels



Source: Authors' depiction.

conducting the grading, is generally stipulated in the contract. Some contractual agreements may require grading by farmers prior to selling; other contracts may leave the grading to buyers who usually hire qualified people to conduct it. Farmers' groups without staff capable of grading the produce generally sell the whole lot without grading.

The grade of the produce is based mainly on physical attributes, i.e., size, color, and length of stem; breed, bud, shape, and the like, which in turn affect the pricing system. Top-grade produce is exported to markets with the strictest quality standards, such as in Australia, Europe, and Japan. Lower-grade produce is exported to countries with less stringent standards and is also sold in local market. Grades A, B, and C are in the higher price range (Lorlowhakarn, Piyatiratitvorakul, and Cherdshewasart 2008), while off-grade produce, i.e. Grade Z,³ receives lower prices and is generally sold in local markets (Appendix 1 provides a sample grading system that has the prescribed attributes of asparagus per grade).

³ Grade Z is the lowest grade of asparagus, including those with crooked and/or very thin shoots.

10.3 WRITTEN VS. VERBAL CONTRACT

Asparagus farmers engage in either a written or a verbal contract with buyers. Exporting firms generally prefer written contractual arrangements that stipulate in detail the necessary procedures from bed making to postharvest handling practices, as well as the attributes and breed of asparagus to ensure compliance with export standards. A typical written contract has the following provisions (i) 1–3-year engagement, (ii) fixed contract price on the first year and renegotiated every year thereafter, (iii) farmers belong to a group under supervision of the firm, (iv) each group has a collection point where both parties meet for transactions, (v) grading of asparagus shoots is done at the collection point by staff of the firms, (vi) payment to individual farmer is made directly in installments within 7 days after collection, and (vii) technical staff of firms visit farmers to provide technical support and monitor the farmers' production system throughout the season.

The verbal contract is an informal agreement between the buyer (collector or exporting firm) and the farmers' group. Some buyers enter into direct contract with individual farmers who can produce in large volume. A verbal contract with a group is made with the group leader who generally manages that group and receives cash support from the buyers. Most farmers receive technical support mainly through the group leader and group members, and sometimes from the buyer. Under a verbal contract, the price agreed can be adjusted depending on prevailing market prices and renegotiated 2–3 times a year. Grading is generally done by a qualified person accepted by both parties. The payment system is similar to that of a written contract; it is made directly in installments within 7 days and through the group leader, who is then responsible for paying individual group members.

In a verbal contract, buyers generally offer cash collateral kept by the group leader, which is used as a revolving fund to procure machinery or other inputs needed in the cultivation of asparagus by the members. To avoid misuse of funds, the group leader is required to inform the company how the funds are to be used before it is disbursed.

To maintain a good marketing relationship with the farmers' group, buyers both under written and verbal contracts may suffer losses during the lean months (in August and September) when demand is low in export markets. Moreover, in the event of payment delays, interest charges incurred are paid by the buyer.

When asparagus contract farming started in Thailand in the 1970s, exporting firms offered only written contracts. Over the years, however, many firms breached their contracts even though they were signed in the presence of the provincial director-general of the Agricultural Extension Department under the Ministry of Agriculture and Cooperatives, and many other witnesses. As a result, the verbal contract evolved and farmers came to view written contracts as burdensome, since without it they are free to sell to any buyer offering reasonable prices and using a fair grading system. In the study area, written contracts are offered by only two export companies—Taniyama and Swift.

10.4 PROFILE OF ASPARAGUS FARMERS

A survey was conducted in 2005 on 148 households: 85 contract asparagus farmers (written or formal) and 63 noncontract asparagus farmers (verbal or informal) in a peri-urban area about 2 hours from Bangkok, the capital of Thailand. The area is a well-developed farming community with well-developed transport infrastructure and market linkages. All asparagus farmers under the survey follow export standards that restrict chemical usage. Most farmers under a written contract whose produce are exported to Europe or Japan were guided by contracting firms or buyers to fulfill the requirements under Good Agricultural Practices along with a few farmers who practice noncertified organic farming.

10.4.1 Household Characteristics

10.4.1.1 *Family Size and Farm Size*

Household characteristics of farmers under written and verbal contracts are summarized in Table 10.1. The analysis shows that farmers involved in written contracts generally have older household heads (3 years older), are more experienced in contract farming (1 year), own bigger parcels of land (71% versus 35%), and have a few more working family members.

The results reflect that those under written contracts cultivate a smaller land area (5.89 rai), which is owned, while those under verbal contracts cultivate a larger land area (9.70 rai) but that is generally leased (Table 10.1). The results are supported by higher land tax dues reported by written contract farmers (who cultivate asparagus on their own land) than by verbal contract farmers (who cultivate on leased land).

The cultivated land of verbal contract farmers is almost twice as big as that of farmers under written contracts. Their ability to produce more volume reduces their need to join farmers' groups and thus many of them operate as independent farmers.

There is no significant difference in the income structure between written and verbal contract households. Both derive income mainly from agriculture, although the amount is larger for verbal contract farmers (562,343 baht vs. 417,078 baht), as they cultivate on bigger land areas. Written contract farmers appear to have more nonagricultural income (10,182 baht vs. 3,398 baht) and more remittance income, although the differences are not significant.

Table 10.1 also reveals higher appraised value for lands under a written contract. To verify if the higher land value reflected higher land quality or proximity to roads and community centers, additional field

Table 10.1 Farm Household Characteristics

Variables	Written Contract	Verbal Contract	p-value
Age of household head (years)	42.48	39.18	0.0279
Education of household head (years)	3.83	4.15	0.4902
No. of working family members	3.23	2.70	0.0206
Contract experience (years in the contract)	4.16	3.31	0.1067
Total land (rai)	5.89	9.70	0.0124
Ratio of own land (%)	71	35	0.0000
Ratio of leased land (%)	28	48	0.0120
Ratio of leased government land (%)	1	17	0.0016
Land price (baht/rai)	159,425	110,180	0.0000
Land tax (baht/rai)	3.65	2.74	0.0688
Land rent (baht/rai)	877.56	764.16	0.6139
Total income (baht)	427,259	565,742	0.0905
Agricultural income (baht)	417,078	562,343	0.0752
Nonagricultural income (baht)	10,182	3,398	0.1220
Ratio of spouse salary to total income (%)	35	29	0.7844
Ratio of wage labor to total income (%)	15	29	0.5476
Ratio of remittance to total income (%)	19	14	0.7980
Ratio of other income sources to total income (%)	15	14	0.9514

Source: Results of ADBI-funded survey in 2004.

interviews conducted in July 2007 revealed that farms owned by written contract farmers have higher soil fertility, indicating sustainable farming practices, owing to long years of farming under close supervision of contracting firms.

10.4.1.2 Access to Credit

Asparagus production generally takes 2–3 years of establishment before regular harvesting can be done; thus, access to credit to cover costs is crucial during the initial stage of the crop cycle. Once harvesting starts, credit is also required to maintain the plants during their productive years. In the study area, credit access is not a problem. As shown in Table 10.2, there is no significant difference in terms of loaned amount sourced from various creditors between the two groups of farmers. Both groups reported having access to credit of amounts more than 8% of their annual income.

The main source of credit is the Bank for Agriculture and Agricultural Cooperatives (BAAC), a government-owned financial institution mainly

Table 10.2 Access to Credit

Variables	Written Contract	Verbal Contract	p-value
Total Credit (baht)	37,414	46,492	0.6211
Credit from BAAC (%)	59	50	0.4999
Credit from coop (%)	3	11	0.2182
Credit from village fund (%)	36	22	0.2294
Credit from group fund (%)	2	0	0.3256
Credit from family and friend (%)	0	13	0.0434
Credit from money lender (%)	0	3	0.1617
Credit for farm cultivation (%)	89.65	89.44	0.9793
Credit for buying agricultural instruments (%)	0.00	31.33	0.1597
Credit for working capital (%)	10.00	0.00	0.0831
Credit for household expenses (%)	0.35	0.56	0.7567
Interest rate average (%)	6.54	6.40	0.8894
Interest rate from BAAC (%)	7.78	8.09	0.7960
Interest rate from village fund (%)	4.08	4.63	0.5304

BAAC = Bank for Agriculture and Agricultural Cooperatives.

Note: The result for interest rate from cooperatives, which was 0.1% for written contract farmers and 6.2% for verbal contract farmers, was excluded due to missing p-value.

Source: Results of ADBI-funded survey in 2004 and author's fieldwork.

serving the rural sector. Credit is also available from the village fund.⁴ The interest rate of credit ranges from 4% charged by the village fund, to 8% of the BAAC, with the village coop charging the average rate of the two, at 6%. Written contract farmers are less likely to borrow from informal sources than verbal contract farmers.

It is important to note that the number of verbal contract members may be underreported. In several groups under verbal contract, a lump sum amount of cash is provided by buyers and serves as a revolving fund for group members to use as working capital. The cash is provided to farmers through the group leader and is used mainly for production activities, particularly during the initial stage of the crop production cycle.

10.4.1.3 *Motivation to Join Contract*

A set of qualitative and multiple choice questions was asked to investigate farmers' motives to join contract farming. The motivation differs between the written and verbal contract groups. For the written contract group, farmers joined the contract primarily for stable prices (47%), followed by an assured market for output and high price (26%), and for more bargaining power (18%). While these three reasons also motivated farmers in the verbal contract group to join a contract, they rated higher price and more bargaining power at 36%—their top reasons for joining; followed by stable prices (30%) and assured market for outputs (20%). These results clearly point to the fact there is a trade-off between price stability and access to market on the one hand, and higher prices and more bargaining power on the other.

It is noted that most farmers under verbal contract in the survey were once under a written contract. In the cultivation of new crops, such as asparagus for export, written contracts provide many benefits to farmers. Farmers gain from the basic infrastructure that a contract farming arrangement gives to contracted entities, such as membership to a farmers' group, timely inputs, and technical support from group leaders and experts from contracting companies, giving contract farmers more opportunities to build relationships with group members. The group relationship in particular allows farmers to increase bargaining power and even facilitate their opting out of the contract if they can find alternative buyers.

⁴ A village fund is a special government program, making funds available to village committees at zero interest rate for the purpose of stimulating the local economy.

Strict grading systems, adherence to numerous contract rules, and presence of alternative buyers often drive farmers to move out of written contractual agreements. Verbal contract farmers may no longer need assured markets that formal (written) contracts provide. The continued operation of both kinds of contract farming relies somewhat on farmers' loyalty to participate actively in the farmers' group.

10.4.1.4 Support Under Contracts and Perceived Changes

Both groups of farmers reported support for pest management, farm maintenance, plant disease control, support for production technology of bio-fertilizers, and timely market information. Most of these issues are better supported under written contracts, as verified by the survey. Of the farmers, 96% in the written contract group agreed that current farm management is better or much better than before, versus 89% in the verbal contract group. In the written contract group, 99% perceived improved knowledge on farm inputs, compared to 92% in the verbal contract group. Better technical support under the written contract serves as an incentive for farmers to continue operating under the strict control and supervision of the contracting firm.

The financial advantage enjoyed by the written contract group is also aptly perceived. Of the written contract farmers, 91% agreed that their financial status is now better or much better than before, compared to only 79% of the verbal contract farmers. Living standards are better than before for 92% of farmers in the written contract group but only 79% in the verbal contract group. The environment is perceived to be better than before by 72% of farmers under a written contract vis-à-vis 62% of farmers under verbal contract. Written contract farmers generally reported more perceived benefits than verbal contract farmers.

10.4.2 Farming Characteristics

10.4.2.1 Production Costs

Asparagus production is mainly for commercial purposes. Table 10.3 shows that the total cultivated area for farmers under a written contract is smaller (3.10 rai vs. 5.47 rai) as they reported smaller plot size than verbal contract farmers to begin with. Under written contracts, farmers incur lower transportation costs, receive technical support, and obtain cash credits from the revolving fund often at zero interest rate.

Table 10.3 Farm Production: Revenues, Costs, and Profits

Variables	Written Contract	Verbal Contract	p-value
Total plant area (rai)	3.10	5.47	0.0018
Harvest ratio for total field (%)	98	100	0.0460
Revenue (baht/rai)	121,856	105,297	0.0023
Asparagus price (baht/kg)	36.69	35.52	0.2463
Yield (kg/rai)	3,406	3,022	0.0099
Ratio of asparagus sold (%)	100	100	0.9649
Ratio of asparagus consumed (%)	0	0	0.0266
Ratio of asparagus other (%)	0	0	0.6344
Cost (baht/rai)	26,087	32,733	0.0015
Cost (baht/kg)	8.14	12.71	0.0002
Ratio of cash in cost (%)	48	53	0.0573
Ratio of labor cost in total cost (%)	64	68	0.1764
Profit per area of land (baht/rai)	95,769	72,564	0.0000
Cash profit per area of land (baht/rai)	109,644	87,601	0.0000

kg = kilogram.

Source: Results of ADBI-funded survey in 2004.

The lower production cost in terms of both per rai of cultivated area and per kilogram of produce is also due to less hired labor, thus less shirking, resulting in higher labor productivity. At the same time, since agrifirms screen farmers and select only those eligible to join contracts, some selectivity bias toward better farmers may have contributed to higher revenue (121,856 baht/rai vs. 105,297 baht/rai).

As similar grades receive the same price both under written and verbal contracts, the higher overall price reported by written contract farmers indicates production of higher grade output (Table 10.3). With a higher yield at lower cost, the written contract group exhibits higher profitability per unit of land (95,769 baht/rai vs. 72,564 baht/rai) than the verbal contract group.

Table 10.4 summarizes the labor cost structure incurred by the written and verbal contract groups. The total labor inputs are not significantly different between the groups. For both, the majority of the labor inputs are provided by family members. Furthermore, nearly half of the labor inputs for both groups were provided by females. As discussed earlier, the cash

cost of labor (per rai of production area and per kilogram of produce) accrued by the verbal contract group is significantly higher due to their use of hired labor.

Table 10.4 Labor Cost Structure

Variables	Written Contract	Verbal Contract	p-value
Labor (person-hour/rai)	1,084	1,174	0.3200
Ratio of family labor in total labor (%)	81	77	0.3108
Ratio of female in total labor (%)	42	46	0.2461
Labor cost (baht/rai)	16,948	21,572	0.0027
Labor cost (baht/kg)	5	9	0.0003
Cash labor cost (baht/rai)	3,842	7,136	0.0008
Cash labor cost (baht/kg)	1	3	0.0031
Ratio of cash labor cost (%)	24	32	0.0389

kg = kilogram.

Source: Results of ADBI-funded survey in 2004.

The input cost structure incurred by the written contract group is comparable to the costs incurred by the verbal contract group (Table 10.5). A significant difference is observed in higher pesticide cost among those in the written contract group and the higher energy cost among those in the verbal contract group. Pesticides used under a written contract are costly as they are of high quality that passed standards of importing countries. While the difference is not significant, the written contract group incurs less cash cost and material costs; and the verbal contract group uses more fertilizers (chemical and compost) than the written contract group.

Yield per shoot and shoot density of the written contract group is slightly higher (but not significant) than those of the verbal contract group. Because of the significantly lower labor cost incurred by the written contract group, yield per labor input, revenue per labor input, income from agriculture per area, and total household income per cultivated area are significantly higher compared to the verbal contract group.

As written contract farmers often have more years of experience in growing asparagus and better cultivation skills owing to technical

Table 10.5 Material Cost Structure

Variables	Written Contract	Verbal Contract	p-value
Material cost (baht/rai)	9,140	11,161	0.2147
Material cost (baht/kg)	3	4	0.0562
Cash material cost (baht/rai)	8,371	10,560	0.1725
Cash material cost (baht/kg)	3	4	0.0394
Seed cost (baht/rai)	988	913	0.6409
Seed cost (baht/kg)	0.3	0.3	0.9403
Ratio of own seed (%)	65	61	0.5853
Chemical fertilizer cost (baht/rai)	3,066	3,779	0.4192
Chemical fertilizer cost (baht/kg)	1.0	1.4	0.2089
Compost cost (baht/rai)	3,470	4,357	0.3494
Compost cost (baht/kg)	1.1	1.7	0.1265
Pesticide cost (baht/rai)	614	292	0.0326
Pesticide cost (baht/kg)	0.173	0.110	0.0839
Machinery (baht/rai)	55	121	0.4201
Machinery (baht/kg)	0.02	0.03	0.5494
Energy (baht/rai)	946	1,699	0.0002
Energy (baht/kg)	0.3	0.6	0.0000

kg = kilogram.

Source: Results of ADBI-funded survey in 2004.

assistance, these factors combined with the use of family labor on smaller landholding result in significantly higher revenue per rai (assuming homogeneity of the two groups of farmers) compared to those engaged under a verbal agreement. The results indicate that, on average, farmers in written contract farming produce more of the higher grade AAA⁵ asparagus in a smaller land area.

⁵ Asparagus are graded based on size of the shoots into grade AAA, AA, and A. Grade AAA receives the highest price and is generally destined for export markets.

Table 10.6 Productivity of Asparagus

Variables	Written Contract	Verbal Contract	p-value
Yield per shoot (kg)	2.18	1.04	0.3356
Shoot density (shoot/rai)	575	451	0.5676
Yield per labor input (kg/person-hour)	4.16	2.98	0.0017
Revenue per labor input (baht/person-hour)	154.07	106.36	0.0023
Income from agriculture per area (baht/rai)	105,588	77,904	0.0039
Total household income per area (baht/rai)	108,236	79,087	0.0013
Total amount of loan	37,414	51,738	0.4845
Returns to loan (revenue per baht of loan)	15.65	8.33	0.1217

kg = kilogram.

Source: Results of ADBI-funded survey in 2004.

10.5 PROFITABILITY COMPARISONS

10.5.1 Simple Mean Comparison

The above initial empirical evidence using simple mean comparison ignores the heterogeneity of the sample farmers within and across the two groups (written contract and verbal contract). The written contract group shows a profitability advantage over the verbal contract group by 22,043 baht per rai (Table 10.3). This indicates that the provisions of a written contract can raise profit from asparagus farming by 25.16% compared to the case where only a verbal contract is involved in the production system. Note, however, that this profit margin may be biased due to the differences among the farmers' groups that were actually engaged in written and verbal contracts.

To address the selectivity bias, the propensity score matching (PSM) method is used so that the profitability comparison is performed with farmers having similar attributes under written and verbal contract farming.

10.5.2 Propensity Score Matching

Using the cross-section data on the same 148 sample farmers, PSM is used to compare the profitability and cost structure of the verbal and written contract farmers' groups, accounting for their characteristic differences as covariates. This method addresses the significant differences in the profile

of sample farmers under written and verbal contracts. Ignoring these differences can possibly mask the differences in profitability between the written and verbal contract groups.

PSM compares the two groups with adjustments on the response (profitability in this case) to account for inherent differences. PSM controls for observable variables, assuming that they are also perfectly measurable. However, the method may not be able to account for all the differences as incentives for individual farmers to choose between written and verbal contracts vary. The motivation for choosing a written over a verbal contract may be an unobserved covariate affecting both farmers' performance (profitability), and thus hidden bias may still occur. In this study, the variables controlled under PSM are:

- (i) Age of household head
- (ii) Education level of household head
- (iii) Farming experience of household head
- (iv) Tenancy
- (v) Number of working family members
- (vi) Number of loans
- (vii) Capital (fixed assets)
- (viii) Integrated pest management (IPM) training
- (ix) Land area

Table 10.7 Results of Logit Estimation of a Farmer's Contractual Choice (written = 1)

Variables	Coefficient	p-value
Constant	0.4776	0.6670
Age of household head	0.0273	0.0810
Education	-0.0377	0.4410
Experience	0.1067	0.0240
Tenancy	0.6548	0.0130
Working family members	0.0635	0.5230
Loan	-0.2760	0.1350
Capital	-0.6338	0.0000
IPM training	-0.1549	0.6980
Land area	-0.1691	0.3810
LR Chi-square	63.18	0.0000
Pseudo R ²	0.3130	
N	148	

IPM = integrated pest management, LR = likelihood ratio, N = total sample.

Source: Authors' calculations.

Table 10.7 presents the logit estimation of a farmer's contractual choice (written contract = 1 and verbal control = 0). As shown in the table, based on degree of significance, variables that determine choice between a verbal and a written contract are (i) level of capital (fixed asset), (ii) tenancy, (iii) farming experience of household head, and (iv) age of household head.

The results appear to suggest that once experience is gained and when sufficient capital is available, larger farmers tend to move from a written contract to a verbal form of contract. The main characteristics of the estimated PSM functions are shown in Appendix 2.

Controlled for the selectivity bias, the results of the PSM comparisons are summarized in Table 10.8. The results show that written contract farmers have a higher cash profit (10,047 baht higher) and lower cash costs (0.86 baht/rai lower), which is similar in direction but smaller in magnitude to the simple mean comparison. However, the degree of statistical significance is drastically smaller. Under PSM, the total production cost under a written contract is higher than under a verbal contract, which is the opposite result compared to the simple mean comparison. This reverse pattern of the total production cost may be explained by the fact that written contract farmers farm more intensively on a smaller piece of land, so when the land size is controlled for using PSM, a more accurate cost comparison is achieved.

**Table 10.8 Propensity Score Matching Comparisons:
Written Contract vs. Verbal Contracts**

Variables	Difference under PSM comparison (written contract minus verbal contract)	t-value
Revenue (baht/rai)	9,825	1.558
Price (baht/kg)	0.87	0.543
Yield (kg/rai)	231	1.143
Cost (baht/rai)	314	0.094
Cost (baht/kg)	-0.86	0.568
Cash cost (baht/rai)	-582	0.284
Cash cost (baht/kg)	-0.64	0.756
Profit (baht/rai)	9,720	1.573
Cash profit (baht/rai)	10,407	1.686

kg = kilogram, PSM = propensity score matching.

Source: Authors' calculations.

Apart from the total production cost, the difference in cost pattern is in the same direction as in the simple mean comparison but is no longer significant. The PSM results reveal that in terms of production costs and profitability, both groups of farmers are not significantly different, indicating no advantage in a written contract over a verbal contract. This implies that once a market of new crops is developed and options are available to farmers, they will self-select themselves into the form of contract that is most suitable for them.

10.6 DISCUSSIONS AND CONCLUSIONS

When asparagus was introduced to Thailand in the 1980s, contract farming was the main institution facilitating the propagation of the new crop to farmers. The labor-intensive farming systems of asparagus production and the tedious farm management necessitate the incentives provided by the buyers in the initial stage of production. By providing technical support and assurance of markets at an agreed price through written contract farming, the crop was successfully introduced and expanded. With a limited number of exporting firms as buyers, farmers opted to stay in a written contract. As the production areas expanded and demand in the local market developed, the number of spot buyers increased, which led to more flexible terms and conditions of contracts in the form of a verbal contract.

The findings show that as the local market evolves, and as technical know-how and credit access are no longer constraints, the more progressive farmers and those with bigger land size tend to move out of the written form of contract farming. Those who continue with the written contract on average have a smaller land size, higher yield, and higher proportion of top-grade asparagus.

If land size is an indicator of wealth or poverty level, it could be said that written contract farmers may have started out from a lower base or were resource-poorer than verbal contract farmers. The fact that the two groups may have different reference points when they joined asparagus contract farming could have contributed to the differential perception. Nevertheless, the result shows that small landholders perceive themselves to have benefited more financially and technically by staying in a written contract, with the added benefit of enhancing the environment.

Beyond perceived benefits, the statistical analysis reveals insights into the actual benefits in terms of higher revenues and lower costs. The simple

mean comparison of profitability shows that written contract farmers earn significantly higher profits than verbal contract farmers. However, the PSM comparison, which controls for selectivity bias, shows that while profitability is still higher among written contract farmers, the differences are not statistically significant. The notion that a written contract is superior or leads to higher welfare of farmers than a verbal contract is not verified by this study.

On the question of effective development strategy, the study yields inconclusive results. On the one hand, written contracts are invariably better than verbal ones under the simple mean comparison, but the same cannot be concluded under the PSM, which took account of possible selectivity bias of farmers' choice of contracts. What this study shows is that the adoption of either the verbal or written contract has more to do with the level of market development for the produce as shown in Appendix 3.

Consistent with findings in Cambodia, the Lao People's Democratic Republic, and other regions in Thailand, this study shows that smaller farmers benefit more from staying in strict contract farming mainly because smallholders or resource-poorer farmers produce small volume of produce and so are more dependent on the contractor to provide them with services such as collection of produce, access to extension services, inputs, and credit. This study also shows smaller farmers under a written contract followed the strict guidance of the contracting firms and worked more intensively on their farms, which they perceived to be an improved farm environment with better resources than the farms of verbal contract farmers. Thus, there is ample evidence of sustainable farming practices for the smaller farmers under a written contract.

The findings suggest that farmers with smaller land size benefit more from the nonfinancial benefits of contract farming by staying in the written contract to produce for high-end export markets. At the same time, this may reflect the fact that the intensive care needed to achieve high-quality produce, and hence higher return per rai, prompts the farmers under a written contract to limit their cultivated area to a small manageable size.

Farmers with a larger land size or more progressive farmers initially join contracts to acquire technical know-how for producing a new crop. However, once production techniques are mastered, they tend to move out of strict contractual arrangements to less restricted contracts where certain benefits of contract farming are maintained. In this case, verbal contracts still allow for collective arrangements of asparagus collection, access to

credit (revolving funds), some level of technical support (from the group leader), and access to inputs, while exposing farmers to a higher risk of price fluctuation. Larger farmers with verbal contracts tend to go for the volume and produce for the domestic or second-tier export markets.

The finding verifies and concurs with results of other studies in this volume: contract farming is most important in the initial stage of market development and in transferring production technology of a new crop to smallholder farmers. However, the importance of contract farming declines as the cultivation methods become widely known and the local market for the crop evolves (Setboonsarng 2006). In the case of producing for agroprocessing firms, particularly exporters to high-end markets, contract farming, particularly in its written form, remains important throughout the different stages of market development.

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APPENDIXES

Table A1 Green Asparagus Grading System Used by Swift Co., Ltd.

Grade	Qualification	Diameter (cm)	Price (baht/kg)
A	Straight spear with compact tip, green in color for 25 cm length without defect from pest and disease	> 1	44
B	Straight spear with little feathered spear has green in color for 25 cm length without defect from pest and disease	> 1	33
C	Straight spear with compact tip, green in color for at least 20 cm length without defect from pest and disease, has whitish end	> 1	40
D	Straight spear with little feathered spear has green in color for at least 20 cm length without defect from pest and disease, has whitish end	> 1	30
E	Straight spear with compact tip, green in color for at least 20 cm length without defect from pest and disease, has whitish end	0.8–0.9	26
F	Straight spear with little feathered spear has green in color for at least 20 cm length without defect from pest and disease, has whitish end	0.8–0.9	21
G	Straight spear with compact tip, green in color for at least 20 cm length without defect from pest and disease, has whitish end	0.6–0.7	15
H	Feathered spear with total length less than 20 cm, pale green color, spear is not round or distorted spear, little defect from pest and disease	> 1	13
I	Feathered spear with total length less than 20 cm, pale green color, spear is not round or distorted spear, little defect from pest and disease	0.6–0.9	7
J	Small spear with both compact and feathered tip	0.3–0.4	4

cm = centimeter, kg = kilogram.

Source: Lorlowhakarn et al. (2008).

**Table A2 Description of the Estimated Propensity
Score Matching Function**

Common support region	[0.0797, 0.9949]
Mean	0.6268
Standard deviation	0.2641
Significance of balancing property	0.01
Number of blocks	6

	Verbal Contract	Written Contract	Total
Observations per block			
Block 1	7	3	10
Block 2	10	5	15
Block 3	9	5	14
Block 4	15	9	24
Block 5	9	26	35
Block 6	1	37	38
Total	51	85	136

Source: Authors’ regression analyses from ADBI survey data.

11. International Social Contract Farming: Case of Banana Export from Thailand to Japan

Tangon Munjaiton, Sununtar Setboonsarng,
and PingSun Leung



11.1 INTRODUCTION

Growing food safety concerns on food contamination and excessive chemical residues, particularly on imported foodstuffs, and increasing awareness of the social and environmental impacts of conventional agricultural production system have led consumers to demand more information on the food they purchase. As a result, importing countries have implemented more stringent standards and have required traceability systems as a food safety auditing mechanism. Public and private standards have proliferated; some focus on sustainable and safe production and others on social issues such as ethical trade. These include Good Agricultural Practices (GAP), Codex Alimentarius, International Federation of Organic Agriculture Movements (IFOAM)¹ Basic Standards (IBS) on organic agriculture, Japanese Agricultural Standards (JAS), United States National Organic Program, Commission Regulation (EC) No. 889/2008 on organic production, and Fairtrade.

Compliance with these standards by producers is verified by a third-party certification agency, which is oftentimes a private firm. On top of these standards, some food importers add their own standards, which is ultimately the real hurdle. The transaction costs involved to ensure compliance with various standards can be very high and may even exceed production costs, making market prices of products uncompetitive, particularly for smallholder producers. To mitigate the high costs of providing food production information, various forms of institutional arrangements have emerged, often as a result of cooperative efforts between consumers, farmers, nongovernment organizations, and governments.

In Japan, an alternative traceability and certification system, known as *teikei*, was developed to ensure consumption of fresh and safe agriproducts. The *teikei* system, which emerged in the 1970s, is an alternative system for

¹ IFOAM is an umbrella organization for the organic movement with over 870 member organizations in 120 countries.

marketing and distribution that bypasses the intermediaries by directly delivering produce from farmers to consumers utilizing the existing framework of cooperatives, which started over a century ago and became institutionally established in the 1970s in Japan. Farmers and consumers recognized that their collective efforts could address their mutual concerns on food safety, health, and the environment, which led to the formation of the *teikei* system (Japan Organic Agriculture Association [JOAA] 1993).

This chapter sheds light on how the *teikei* system has influenced implementation of contract farming of organic produce overseas; in this case, between a consumers' cooperative in Japan (Shutoken Consumers Cooperative [SCC] in Tokyo) and a farmers' cooperative in Thailand (Banlat Agricultural Cooperatives [BAC]²) to produce organic bananas. This chapter discusses the origins of the *teikei* system and the setting up of *teikei*-like contract farming arrangements, including special features of the contracts giving producers a chance to interact with their consumers, and attempts to explain how *teikei*-like systems affected profitability.

11.2 THE TEIKEI SYSTEM

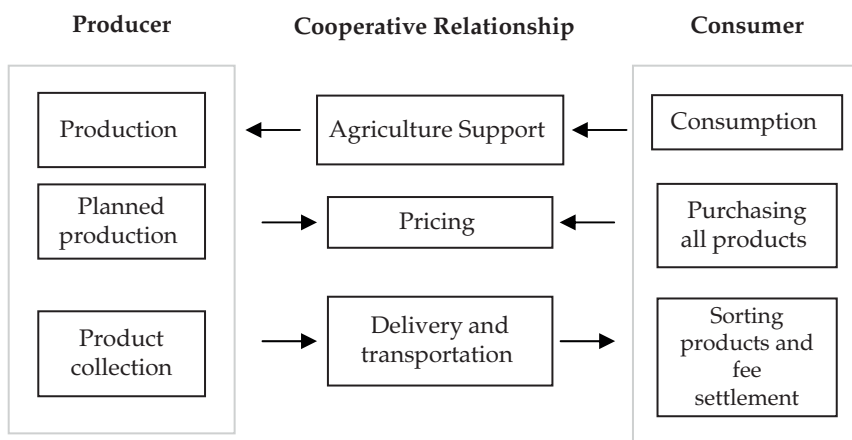
The practice of *teikei* is often tied in with the establishment the Japan Organic Agriculture Association (JOAA) in 1971 (Ikegami 2010). JOAA could be seen as a culmination of the efforts of consumers and producers for safer food for humans and the environment, amidst the dizzying pace of Japanese industrialization. Along with JOAA, the idea of “organic” was introduced in Japan in the 1970s.

The concepts of “organic” were espoused by the consumer movement calling for nonchemical production of agriproducts to build a mutually supportive relationship between producers and consumers and by the rural health movement (Ikegami 2010, Prayukvong 2005). The movements formed as a response of farmers who witnessed the deleterious effects of agrochemical inputs on health and the environment and of consumers concerned about food safety as contaminated foods from industrial waste made headlines in the 1970s (Makino and Ping 2010).

Organic farmers used a market distribution system called *teikei* to facilitate the implementation of their ideas in a market-led society. *Teikei* has three components: production, consumption, and cooperation between them (Figure 11.1). The system gained popularity in the 1980s (Ikegami 2010).

² Agricultural group and agricultural cooperative are used interchangeably in this chapter.

Figure 11.1 Fundamental Aspects of the *Teikei* System



Source: Ikegami (2010).

In essence, *teikei* is a form of contractual arrangement between farmers and consumers, which allows consumers to directly contract farmers to produce food based on their specifications bypassing local traders or intermediaries in the transaction.

The mechanics of the *teikei* system are as follows (Ikegami 2010):³

1. Organic farmers employ mixed cropping⁴ to ensure a variety of produce and to minimize crop failure.
2. Organic farmers collect products at a predetermined schedule from their group at their own expense to be transported to consumer groups.
3. Consumers go to designated pickup points as scheduled and sort out products to be brought home after settling their respective fees.
4. As stated in the business plan, consumers are encouraged to bring home all products delivered to pickup points by producers and pay prices in consideration of farmers' production costs and market prices.
5. Consumers and farmers create agricultural support groups to promote mutual understanding between them.

The special features of *teikei* include occasional participation of consumers in production activities and joint risk-sharing arrangements. For example, in *teikei* rice contract farming, consumers are sometimes invited to participate in weeding activities to understand the hardships of growing crops and to show appreciation to agrifood producers. The visits by

³ See Appendix 11.1 for a summary of *teikei* principles.

⁴ Mixed cropping in this context means cultivation of many kinds of crops in small quantities.

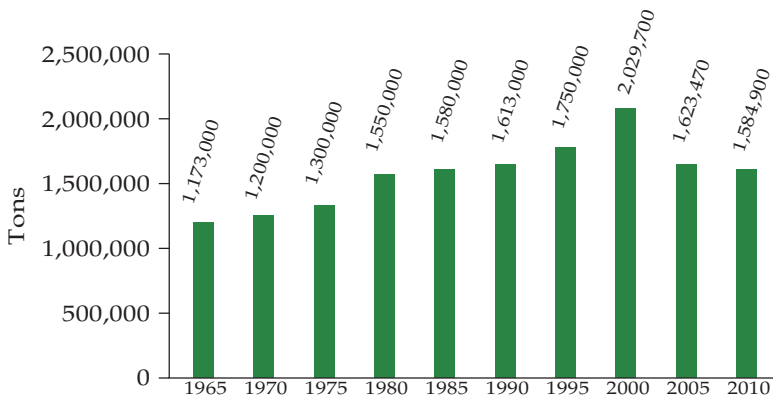
consumers to agrifood production systems also serve as a monitoring system on food production methods and thus replace the need for a formal certification system by a third-party certifier. With globalization and trade liberalization in the 1990s, innovative forms of *teikei* have been extended to farmers outside of Japan, taking advantage of lower costs of production in developing countries.

11.3 BANANA PRODUCTION IN THAILAND

As demand for chemical-free and noncertified organic bananas in the Japanese market increased, consumer cooperatives in Japan began extending their sourcing to Thailand in the 1980s, with the goal of operating a direct contract farming scheme similar to the *teikei* system, which facilitates the forming of a face-to-face relationship between farmers and consumers. The search identified potential cooperatives in a banana growing area in the provinces southwest of Bangkok to grow chemical-free or noncertified organic Gros Michel bananas.⁵

The total volume of banana production in Thailand has stabilized through the years, although there has been a downward trend since its peak in 2000 (Figure 11.2). The majority of bananas produced are for domestic consumption (Chanadee et al. 2011).

Figure 11.2 Total Banana Production in Thailand (1965–2010)



Source: FAOSTAT Database.

⁵ See Appendix 11.2 for commercial varieties of bananas grown in Thailand.

The Gros Michel variety, while still a small portion of the total banana exports, has been an expanding export crop in the last decade. It experienced dramatic growth in export volume from 663 tons in 1995 to 2,115 tons in 2004, about 96% of which on average was destined for the Japanese market. Sustainability of the export market is properly cushioned with proportional growth in domestic production. Almost all of the banana export transactions are produced under contract farming schemes.

11.4 THE CASE STUDY: ORGANIC BANANA CONTRACT FARMING

The export of Gros Michel bananas to Japan began in 1991 between Tayang Cooperatives in Petchburi Province and Toto Consumer Cooperatives in Japan. Another farmer group (Lamae in Chumporn Province) began exporting Gros Michel in 1993 to Yodogawa Consumer Cooperatives in Osaka, Japan, through the Pan Pacific Food Corporation (PPFC), an export agency.

In this case study of contract farming involving Shutoken Consumer Cooperatives (SCC) from Japan, when this group was looking for Thai farmers to produce organic bananas, they realized that a contractual arrangement could not be extended directly to farmers' cooperatives in Thailand, as these cooperatives did not have the capacity to handle export procedures. Hence, an export agency, the PPFC was tapped as an intermediary to extend the contract to a producers' cooperative, in this case the Banlat Agriculture Cooperatives (BAC), which in turn extended the contract to each of its member farmers.

Initial discussions between the PPFC and BAC started in 1993, and it took 3 years to improve the soil and to retrain farmers, moving them from input-intensive conventional banana production to chemical-free agriculture of export quality.⁶

In 1996, a former inspector-general of the Ministry of Agriculture and Cooperatives introduced the PPFC chairman to the BAC manager. This led to the proposal from the PPFC to engage BAC in exporting Gros Michel bananas to Japan. In July 1999, the PPFC chairman invited a team from SCC to visit BAC, leading to the signing of an agreement to export bananas. The Deputy Minister of the Ministry of Agriculture and Cooperatives and the Director-General of the Department of Agricultural Extension served as

⁶ Please see Appendix 11.3 for details on BAC as an organization.

witnesses to the contract signing and whose presence signaled government support of the arrangement.^{7,8}

11.4.1 Contractual Arrangement

Under the contract farming agreement, BAC provides all aspects of technical support, including training for soil preparation, provision of selected banana shoots, biological control of pests and diseases, as well as monitoring at all stages of growth of the banana crop. The farmers serve as caretakers of the bananas until harvesting. At harvest, BAC staff provide the logistics for harvesting, transporting, and postharvest treatment of the bananas. Farmers receive a guaranteed price, which is slightly lower than the market price, but they have guaranteed market access and can avail of the many services provided by BAC.

11.4.2 General Rules and Regulations between BAC and the PPFC

The BAC and SCC protocols signed included general agreements for growing organic bananas for export:

- (i) Inform BAC officers of quantity of banana shoots to be planted prior to actual planting.
- (ii) Avoid the application of agrochemicals in the banana plantation.
- (iii) Avoid growing of other crops that may require chemical inputs in the banana plantation.
- (iv) Apply organic fertilizers and acquire knowledge on soil fertility improvement without using chemicals.
- (v) Forfeit membership after 1.5 years of not selling bananas to BAC.
- (vi) Contribute to the mutual funds at a specified rate (typically less than a percentage of the sales value of bananas, e.g., 0.05% per 100 baht worth of sales).
- (vii) BAC should make available to consumers at all times the farm inputs recording system and supply chain traceability system.

⁷ The narrative in this section is mainly from the authors' field visits and interviews.

⁸ Please see Appendix 11.4 for details on the dynamics of the contract farming case study.

11.4.3 Face-to-Face Relationship between Producer and Consumer

One unique feature of this cross-country contract farming arrangement is its *teikei*-like system. Strictly speaking, agrifood products involved in *teikei* entail fewer food miles as farmers and growers often live in the same area and farmers grow a variety of produce to lessen crop failure and to supply all of the vegetables and fruits needed by their consumers. The part of this case study of contract farming that resembles *teikei* is the face-to-face interaction between food producers and consumers to build a relationship based on trust and respect, and the promotion of sustainable agricultural production.

To facilitate personal interaction, an agreed percentage of proceeds from sales of bananas is mandatorily set aside for a “special fund,” which is used to facilitate visits of Thai farmers to homes of consumers in Japan; the special fund also contributes to the welfare fund which compensates losses of farmers from natural calamities. Each year, two to three farmers are selected as “good producers” and are rewarded with a trip to Japan.

The “special fund” finances travel costs, i.e., airfare and allowance while farmers are hosted by Japanese consumers in their homes. The travel reward often serves as a motivation to perform well. Trip participants are acknowledged for their responsible farming practices, which instill pride among them. For the consumers, it is an opportunity to show gratitude to the producers of safe food.

Members of consumers’ cooperatives also visit BAC banana farmers and their farms in Thailand.⁹ The visits from consumers are designed to facilitate understanding of the banana-growing process in hopes of fostering appreciation for chemical-free bananas and to instill confidence regarding food safety standards of products. The visits also serve a supervisory function, which eliminate the need for a third-party certification system. This significantly cuts the incidental costs that otherwise burdened farmers. The social tie formed during visits between producers and consumers is an implicit food safety monitoring system, as well as a market guarantee. Moreover, these visits also facilitate cultural exchange, which could improve understanding between the two different cultures and lifestyles.

⁹ Some Japanese visitors opt for a homestay with Thai farmers, while others book nearby hotels.

11.4.4 Risk-Sharing Mechanism

Agricultural production involves high risks of pest infestation and natural disasters. With a long-term face-to-face relationship facilitated under this contractual arrangement, it became possible to include risk-sharing mechanisms in contractual agreements. Given that consumers value safe food products of farmers, they were more willing to enter into risk-sharing schemes to facilitate long-term availability of safe bananas for consumption. Under the agreement, in the event of total crop loss due to natural disasters, consumers would share 30% of the value of the loss.

11.4.5 Banana Distribution Channel

The banana distribution channel of BAC is straightforward. BAC staff transport harvested bananas from the orchard to the packinghouse where the bananas undergo cutting, grading, cleaning, drying, checking for insects, and packaging. BAC takes full responsibility for the process.

The PPFC buys from BAC all in-grade bananas after the processing. In-grade bananas are those whose weight is 100–120 grams, whose sweetness meets the standard, and whose peels have no defects. The bananas are exported to the SCC in Tokyo. Off-grade banana are sold to the wholesale and/or retail traders locally.

There is often a production surplus in August and September due to favorable weather, which is also the time when demand for bananas in Japan is low; hence, the PPFC usually sells the surplus to the local wholesale and/or retail markets in these summer months.

11.4.6 Independent and Contract Banana Farmers

Aside from the contracted farmers, independent farmers also grow bananas in smaller scale for sale in local markets, targeting festival events when the price is high. Independent farmers who also grow other crops often bring bananas to the market to be sold directly to retailers at a higher price.

Unlike independent farmers, contract farmers have farms located in less fertile land; hence, they do not have many other income earning options. The provision of inputs and technical services, the assured market, the social relationship with consumers, and the risk management funds provided by the consumers in years of calamities are among the strong

points of the contractual arrangement, aligned with the current trend of promoting ethical trade.

11.4.7 Issues of Organic Banana Contract Farming

While contract farming of organic bananas is financially attractive to farmers, it is not without technical difficulties. During the initial years after conversion from chemical-based production, yields generally decline for 1–3 years before increasing after soil fertility improves with organic practice. In addition, plant diseases and infestation affect the appearance of organic bananas, causing them to be rejected in the export market. Off-grade bananas are sold at substantially lower prices in local wholesale markets. Production is also affected by inadequate water during the dry season, which lowers productivity. Intercropping is also discouraged in the banana orchards for fear that it might introduce chemicals to the orchard, which could substantially lower growers' incomes.

BAC and the PPFC also face problems associated with the contract. Each banana shoot can be harvested only once a year, although harvest can be done year-round. During the months of February and March, production is very low; hence, BAC incurs a financial loss. Surplus production occurs in August and September, but it is coupled with low export demand, which results in losses for both BAC and the PPFC.

11.4.8 Success of BAC Contract Farming

The success of the project could be attributed largely to the strong commitment among the leaders in the supply chain. Apart from the BAC manager, the interpersonal skills of the PPFC committee chairman (a Japanese national), who has an understanding of cultural nuances and good relationships with all parties, were essential. Among banana growers, technical know-how on banana growing, compliance with rules and regulations, and BAC membership to accrue a volume viable for export are also crucial.

Briefly, the five main factors affecting sustainability of the Banlat Banana Contract Farming project are (i) human resources; (ii) cash flow; (iii) supply of production inputs; (iv) packaging and/or processing materials; (v) management of the different institutions; and (vi) external support that can come from the government, nongovernment organizations, or private firms.

On the financial aspects, BAC and the PPFC need sufficient capital to invest in physical infrastructure necessary for the operation. The individual farmers also require credit to procure adequate production inputs. The contribution of the SCC of seed capital for interest-free credit attracts farmers to join the contract and enhances profitability of farming operations. It is also important that inputs and financial disbursements are timely to build trust among farmers in the system and the people involved, motivating them to continue participating in the project.

To be able to meet the contract volume and quality at specified prices, it is important that production inputs are available at reasonable cost. Availability of packaging and/or processing materials will ensure proper handling of the produce so that the bananas reach consumers in a condition within the specifications of the contract.

The collaborative effort of BAC and the PPFC in supervising the farmers further contributes to the sustainability of the project. The information system that records the production status and inputs by farmers and the demand situation of the consumers is an indispensable instrument in production planning to determine the supply–demand equilibrium that falls within the contract perimeters. The support of the local government and other entities outside the production contract cannot be discounted in ensuring sustainability of the project.¹⁰

11.5 METHODOLOGY

The empirical analysis in this chapter is based on a case study of the Banlat Banana Growers Group in Petchburi Province, Thailand. The data used in analyzing the dynamics of banana contract farming consist of in-depth interviews with key informants, including the personnel of both BAC and the PPFC, and the farmers' group leaders in 2005.¹¹

The guiding questions for the in-depth interview covered four major themes:

- (i) The formation of banana contract farming in Banlat district, Petchburi Province
- (ii) The operation of Banlat banana contract farming
- (iii) Problems related to Banlat banana contract farming
- (iv) Factors affecting the sustainability of Banlat banana contract farming

¹⁰ Please see Appendix 11.5 for details on the roles of BAC, the PPFC, and the SCC in the contractual arrangement.

¹¹ Please see Appendix 11.6 for a review of contract farming systems in Thailand, which provides early leads on the design of the study.

To further analyze the impacts of contract farming, a sample survey of banana growers was conducted among 74 contract growers and 36 independent growers. The major data items collected included:

- (i) productivity per rai,
- (ii) type and extent of support received from contracting parties,
- (iii) changes in farm practices,
- (iv) knowledge of farm practices,
- (v) changes in the quality of life of the households, and
- (vi) changes in the social network within the community.

11.5.1 Propensity Score Matching

The groups joining or not joining the contract are not necessarily comparable. A direct comparison of profitability between the two groups may exhibit differences in their initial profile and are not necessarily a result of contract engagement or nonengagement. To address this problem, propensity score matching (PSM) is used.¹²

PSM is used on the cross-section data of 110 sample farmers to compare the profitability of the contract and noncontract farmers' groups, accounting for their characteristic differences as covariates. This will address the significant differences in the profile of sample farmers under contract and among the independent farmers. If these differences are not taken into account, it is possible that differences in profitability between the two groups cannot be attributed to the contract but to profit-improving peculiarities among the groups.

11.6 SAMPLE PROFILE

The survey yielded responses from a total of 110 farmers—74 contract growers and 36 independent growers of bananas in Petchburi Province of Thailand. The demographic profile of the contract and noncontract farmers is quite similar except for farm acreage and its associated tax and rent (Table 11.1).

The average age of the household head is 48 years and 52 years, respectively, among the contract and independent growers. In both groups, the household head has over 6 years of education with nearly three adult family members per household.

¹² Please refer to Chapter 3 of this volume for details on PSM.

Table 11.1 Socio-Demographic Profile of Respondents

Variables	Contract	Noncontract	p-value
Age of household head	48.01	51.75	0.1024
Education of household head	6.43	6.17	0.7391
No. of adult family members	2.88	2.75	0.5853
Contract experience (years in the contract)	3.99	0.00	0.0000
Organic (yes = 1; no = 0)	0.92	0.06	0.0000
Total land (rai)	15.02	7.90	0.0002
Ratio of own land (%)	76.00	78.00	0.8607
Ratio of leased land (%)	19.00	16.00	0.6591
Ratio of government leased land (%)	0.68	0.00	0.3206
Land price (baht/rai)	115,568	163,611	0.2293
Land tax (baht/rai)	1.59	3.71	0.0208
Land rent (baht/rai)	55.54	350.00	0.2747
Total income (baht)	162,544	138,584	0.3008
Nonagricultural income (baht)	118,014	114,830	0.8647
Income from wages and salary (baht)	44,530	23,754	0.1331
Proportion of spouse's salary (%)	14	9	0.6280
Proportion of wage labor (%)	17	7	0.1292
Proportion of remittance (%)	18	14	0.6933
Proportion of other income (%)	21	36	0.3513

Source: Results of survey and authors' field visits in 2005.

The contract farmers have been engaged in contracts for almost 4 years. The total cultivated land of contract farmers is significantly larger (almost double) than the land area of noncontract farmers. This is a reflection of the selection process, wherein possible participants to contract farming are prescreened based on farm size, as this is an important consideration to meet volume requirements necessary for contracts with banana importers.

There is no significant difference in land tenure profile between the contract and independent farmers; both have negligible or no government-leased lands. However, appraised land values of contract farmers are lower than those of independent farmers. As a result, land tax (significantly less than half that of independent growers) and land rent (over seven times less) are much lower among the contract growers due to lower soil fertility as most contract farmers have marginal lands. As specified in the contract, almost all (92%) contract farmers do not use any chemicals in growing bananas.

Table 11.1 shows that there is no difference in the simple mean income structure between the contract and independent farmers. The slightly higher total income among the contract farmers is explained by the larger cultivated area.

There is no difference in the nature of credit available to contract and noncontract farmers (Table 11.2). The total amount of credit availed is within the vicinity of 20% of the annual total income for both groups.

Table 11.2 Availability and Nature of Credit

Variables	Contract	Noncontract	p-value
Credit total (baht)	31,202.70	30,583.33	0.9667
Credit from BAAC (%)	23.00	38.00	0.3429
Credit from coop (%)	47.00	31.00	0.2746
Credit from village fund (%)	29.00	32.00	0.8783
Credit for farm production (%)	87.13	100.00	0.1974
Credit for farm tools/machinery (%)	5.33	0.00	0.1741
Credit for working capital (%)	3.33	0.00	0.3256
Credit for house construction (%)	3.33	0.00	0.3256
Credit for household expenses (%)	3.33	0.00	0.3256
Credit for buying animals (%)	3.06	0.00	0.2391
Credit for buying land (%)	3.33	0.00	0.3256
Interest rate total (%)	6.98	6.90	0.9401
Interest rate of BAAC (%)	7.75	7.17	0.6549
Interest rate of coop (%)	8.16	10.10	0.2506
Interest rate of village fund (%)	4.82	4.50	0.8442

BAAC = Bank for Agriculture and Agricultural Cooperatives.

Source: Authors' calculations.

The sources of credit, purpose, and interest rate paid to different sources are also comparable between the two groups although contract farmers have higher access to credit from coops than from government sources, i.e., the Bank for Agriculture and Agricultural Cooperatives (BAAC) and the village fund (Table 11.2).

Contract farmers also have higher access to credit for other purposes, which serves as an incentive for farmers to join. Independent farmers only have access to production credit, although the use of credit for other purposes is not significant. In addition to slightly better access to credit,

contract farmers also face a slightly lower interest rate for credit from coops, although not statistically significant.

The simple mean revenue and cost of banana production are presented in Table 11.3. Banana growing areas of contract farmers are higher at over 3 rai versus 2.51 rai for independent farmers. Revenue, price, yield, and profit are not different between the two groups. The ratios of bananas sold and consumed are statistically significant for both groups; nearly all of the bananas produced are sold.

Table 11.3 Revenue, Cost, and Profit from Banana Growing

Variables	Contract	Noncontract	p-value
Total cultivated area for bananas	3.08	2.51	0.1649
Harvest ratio for total field (%)	98	97	0.8247
Revenue (baht/rai)	20,887	21,384	0.8012
Price of bananas (baht/kg)	68.91	71.68	0.4939
Banana yield (kg/rai)	312.65	310.53	0.9169
Ratio of bananas sold (%)	98	99	0.0232
Ratio of bananas consumed (%)	2	0	0.0355
Cost of growing bananas (baht/rai)	10,278.35	14,376.34	0.0514
Cost of growing bananas (baht/kg)	38.43	52.34	0.0804
Ratio of cash cost in total cost (%)	62	62	0.9580
Ratio of labor cost in total cost (%)	47	51	0.2926
Profit per area of land (baht/rai)	10,608	7,008	0.1224
Cash profit per area of land (baht/rai)	14,690	1,3657	0.5230

kg = kilogram.

Source: Authors' calculations.

The cost of growing bananas in terms of baht per rai, however, is more expensive for noncontract farmers. This may be due to the application of agrochemical inputs. This more expensive production for noncontract farmers is also reflected in more baht spending per kilogram of bananas. Hence, profitability is expected to be higher for contract than for noncontract farmers, although the result is not significant. Both groups have similar ratios in terms of cash and labor costs in total costs.

In terms of labor input, the results are significantly higher for noncontract farmers, as shown in the labor cost per rai and labor cost per kilogram of output (Table 11.4). However, other labor-cost specifics are not statistically

significant between the two groups, although the numbers are higher for noncontract farmers. It is also noted that the labor cost (baht/rai) may be overestimated due to the difficulties in separating the labor cost for banana cultivation from other farm activities.

This finding defies the general perception that organic production is more labor-intensive. However, as this study presents a case of farmers practicing organic farming for an average of 4 years, the soils and ecosystems may have already been restored, leading to healthy banana plants and reduced pest infestations and banana plant diseases.

Table 11.4 Labor Cost Structure

Variables	Contract	Noncontract	p-value
Labor (person-hour/rai)	222	269	0.2170
Ratio of family labor in total labor (%)	76	72	0.4385
Ratio of female in total labor (%)	43	43	0.9132
Labor cost (baht/rai)	5,132	8,391	0.0493
Labor cost (baht/kg)	19	31	0.0490
Cash labor cost (baht/rai)	1,501	2,352	0.0545
Cash labor cost (baht/kg)	6	8	0.1620
Ratio of cash labor cost (%)	33	40	0.1578

kg = kilogram.

Source: Authors' calculations.

Although the material costs per cultivated area and per kilogram of output are not significantly different between the two groups, those of independent growers are slightly higher than those of contract growers. As expected, this is particularly significant for pesticides, whose costs are higher for independent growers (Table 11.5). This is consistent with the fact that pesticides are a significant production expense for conventional farmers.

As expected, the cost of compost is higher among the organic contract farmers, although statistically not significant. This is again explained by fewer and more readily available production inputs found in farms.

In terms of seed costs, they are comparable between the two groups, but machine costs are expectedly lower for contract farmers as membership in the cooperative defrays machine and energy costs.

Table 11.5 Material Cost Structure

Variables	Contract	Noncontract	p-value
Material cost (baht/rai)	5,146	5,985	0.3382
Material cost (baht/kg)	20	21	0.6340
Cash material cost (baht/rai)	4,696	5,375	0.4203
Cash material cost (baht/kg)	17	19	0.5674
Seed* cost (baht/rai)	1,343	1,298	0.7137
Seed cost (baht/kg)	5.1	4.7	0.5872
Ratio of own seed (%)	31	39	0.4313
Chemical fertilizer cost (baht/rai)	1,668	2,176	0.4196
Chemical fertilizer cost (baht/kg)	7.2	7.7	0.8350
Compost cost (baht/rai)	1,504	1,350	0.7141
Compost cost (baht/kg)	4.9	4.5	0.7042
Pesticide cost (baht/rai)	0.9	56	0.0536
Pesticide cost (baht/kg)	0.002	0.242	0.0219
Machinery (baht/rai)	49	122	0.3370
Machinery (baht/kg)	0.15	0.40	0.2626
Energy (baht/rai)	581	982	0.0336
Energy (baht/kg)	2.2	3.6	0.0689

kg = kilogram.

* Seed refers to banana shoots.

Source: Authors' calculations.

11.7 PROFITABILITY UNDER CONTRACT

The PSM method is used on the cross-section data of 110 sample farmers to compare the profitability of the contract and independent farmers' groups, accounting for their characteristic differences as covariates. This will address the differences in the profile of sample farmers under contracts from that of the independent group.

PSM compares the two groups with adjustment on the response (profitability in this case) to account for inherent differences. This method can be constrained because the incentives that the individual farmers consider in joining the contract could vary; thus, there may be a hidden bias. PSM only controls for observable variables (assuming that they are also perfectly measured). The motivation for joining may be an unobserved covariate affecting both farmer groups' performance

(profitability) and their choices of joining the contract. Selection models can be used to address unobservable selection biases in deciding to join the contract or not.

Models will be constructed with net profit (per unit of land) defined as the revenue (including those produced for own consumption) less expenses (including own labor, seeds, and other inputs that are not necessarily procured from commercial sources). Due to data limitations, an ad hoc profit function is fitted to include only land, capital, and family labor.

11.7.1 Simple Mean Comparison

The unadjusted profit among the contract farmers' group averages 10,608 baht per rai while that of the independent farmers' group averages 7,008 baht per rai. Without consideration of the intrinsic differences between the contract and the independent groups, the raw incremental increase in profit brought by contract farming is 3,600 baht; this, however, is not statistically significant ($p < 0.1224$) (Table 11.3).

The insignificance of the profit difference is caused by the highly varied profits among farmers within the same group and across groups. This is possibly caused further by the individual differences among farmers influencing their profitability. Those farmers with favorable endowments will surely turn out to be more profitable.

11.7.2 Propensity Score Matching

The gains of contract farmers over the independent farmers were computed for various indicators using PSM. The contract farmers exhibited minimal advantage (not statistically significant) over the independent farmers.

The profit edge of the contract farmers over the independent farmers is estimated at 5,387 baht (Table 11.6), but this difference is not significant ($p < 0.1182$). It is possible that PSM was not able to detect a statistical significance of the profit advantage of contract farmers over independent farmers because of hidden selection bias. It may be that the individual farmers joining the contract have hidden motivations for joining or that the determinants included in PSM were not able to correctly account for motivations affecting individual profitability.

**Table 11.6 Propensity Score Matching Comparisons:
Contract vs. Noncontract**

Variables	Difference under PSM Comparison (Contract minus Noncontract)	t-ratio
Revenue (baht/rai)	408	0.199
Rice price (baht/kg)	-1.34	-0.322
Yield (kg/rai)	2.04	0.121
Cost (baht/rai)	-4,980	1.760
Cost (baht/kg)	-16	1.482
Cash cost (baht/rai)	-1,901	1.652
Cash cost (baht/kg)	-6.64	1.244
Profit (baht/rai)	5,387	1.576
Cash profit (baht/rai)	2,039	1.192

kg = kilogram, PSM = propensity score matching.
Source: Authors' calculations.

An endogenous switching regression model has been attempted using the data on 74 contract and 36 independent banana farmers in Thailand. The results support the aforementioned methodologies, which showed land size contributing significantly to contract participation ($p < 0.0200$). The results also indicate that capital, labor, education of the household head, and integrated pest management training may contribute to contract participation, but their contributions based on the data are not statistically significant. In essence, both contract and independent farmers choose the correct or appropriate strategies given their production endowments; hence, farmers that choose to enter contracts are better off under contracts, while independent farmers are better off outside contracts.

11.8 CONCLUDING NOTES

Profitability is a prime motivator for farmers to move out of or stay in a contract. Profitability is jointly affected by the scale factor (large farm size) and lower production costs resulting from contract terms. Although contracting can result in efficient utilization of land and capital that will enhance profitability, this may not be so for independent farmers.

The banana farmers analyzed in this study indicated that the prescreening helped farmers decide which engagement strategy (contract farming vs.

independent farming) was appropriate for their respective individual endowments. The prescreening procedure also resulted in the land size being significant in the selection model. Farmers with a relatively large farm size are more likely to join a contract than those with a smaller land size.

It is interesting to note that given their individual characteristics, it is ideal for the contract farmers to be in the contract and for the independent farmers to be independent. Farmers hence can discern for themselves which strategy will make them better off.

There are numerous benefits for contract farmers in this case study; they benefit from inputs, particularly credit access as initial production after the transition to organic farming is often done at a loss. The farmers also benefit from the monitoring and supervision functions performed by contractors who perform certification of produce saving farmers certification costs. There is also an advantage in the use of production inputs and equipment in the context of cooperative sharing of these resources; this can also reduce costs. The contract further allows farmers to visit consumers in Japan, and Japanese consumers in turn to do a homestay with the farmers' family in Thailand, which promotes trust and confidence between them.

However, the effects of the *teikei*-like system on costs are not clearly evident in the results, as it is difficult to separate their effects in the models. Since the *teikei*-like system is part of the contract provisions, one can attribute the lower labor cost and overall profitability of organic contract farmers as indications of its positive effects. As farmers are motivated to perform well to receive the travel reward, they may do extra work to improve quality and quantity of yields. They could be more attentive in postharvest processing to lessen spoilage and rejection at destination markets, increasing profitability. Nonetheless, a separate study is warranted to particularly itemize the specific effects of the *teikei*-like system.

As organic contract farming prohibits application of chemical inputs, crop diversification (which can augment farm income) at the production site is difficult. Moreover, awareness of organic farming benefits is often low in rural areas; hence, farmers can be easily attracted to the high yields–high profits of conventional farming. As markets for organic produce are developed, however, the financial benefits of organic farming will improve. With more local and international awareness surrounding production of

healthy and safe food, consumers will be more willing to pay premium prices for green produce.

As this case study showed, contract farming includes marginal farmers in global trade; hence, it can be considered a pro-poor development strategy. While there is a bias toward “larger” land holders and higher-skilled farmers among the smallholders, the fact remains that these smallholders could not have benefited from the technical know-how, gained market and credit access, and been provided appropriate production inputs, had it not been for contract farming.

Finally, this *teikei*-like contract farming promoted sustainable production that both consumers and producers value, doing away with costly certification systems that hamper trade for smallholders. However, for this venture to continue, the farmers, contractors, and consumers, with government providing an enabling environment in terms of support services and policies, should constantly seek ways to enhance their collaborative effort.

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APPENDIXES

Appendix 1 A Summary of the Ten Principles of *Teikei*

1. To build a friendly and creative relationship, not as mere trading partners.
2. To produce according to prearranged plans on an agreement between the producer(s) and the consumer(s).
3. To accept all the produce delivered from the producer(s).
4. To set prices in the spirit of mutual benefits.
5. To deepen the mutual communication for the mutual respect and trust.
6. To manage self-distribution, either by the producer(s) or by the consumer(s).
7. To be democratic in the group activities.
8. To take much interest in studying issues related to organic agriculture.
9. To keep the members of each group in an appropriate number.
10. To go on making a steady progress even if slow toward the final goal of the convinced management of organic agriculture and an ecologically sound life.

Source: Japan Organic Agriculture Association (1993).

Appendix 2 Commercial Varieties of Banana

Group	Subgroup	Cultivars
AA		<ul style="list-style-type: none"> • Kluai Khai; syn. Pisang Mas, Sunny Bunch, Golden banana, Sucrier banana • Kluai Leb Mua Nang
AAA	Cavendish	<ul style="list-style-type: none"> • Kluai Hom Khiew; syn. Pisang Masak Hijau • Khuai Hom Khiew Korm; syn. Dwarf Cavendish • Grand Naine • Williams • Kluai Nark; syn. Red banana
	Gros Michel	<ul style="list-style-type: none"> • Kluai Hom Thong • Kluai Hom
ABB		<ul style="list-style-type: none"> • Kluai Hug Mook; syn. Silver Bluggoe, Kluai Som • Kluai Nam Wah; syn. Pisang Awak • Kluai Hin; syn. Saba

Source: Thai Agricultural Standard. 2005.

Appendix 3 Banlat Farmers' Group/Cooperative

When the group was formed in 1996, there were only about 100 members. At present, there are 333 members from 7 subgroups (formed by site location). In January 2005, only 176 members grew bananas, while others shifted to other crops for the regeneration of soil fertility but will eventually go back to banana farming. Each of the seven subgroups is headed by a leader voted among members of each area. The total membership of each subgroup is given in Table A3.1.

**Table A3.1 Membership Size of Each Subgroup
of Banlat Farmers' Cooperative**

Group Name	Members
Lum Samor	12
Rai Saton	102
Bansong	28
Nongfab	125
Mabplakao	39
Bangkuay	18
Putum	9

Source: Authors' field visits and surveys.

The subgroups are not stand-alone in the sense that there are not even committees formed within them. The fact that there are subgroups with very few members (Putum and Lum Samor) links them stronger to the Banlat Farmers' Group. The group leader has only a coordination function, received no compensation, and is elected by the members because of his good relationship with other members and technical knowledge about banana farming. The group leader may act as a resource person on banana growing when no other expert is present on-site. The group leader helps the Banlat Agricultural Cooperative and the Pan Pacific Food Corporation personnel in disseminating information or relaying messages to other members. When field visits are made by the different stakeholders, the group leader serves as a coordinator among the member farmers.

Appendix 4 Dynamics in Banlat Contract Farming

The prime movers in the formation of Banlat contract farming are the Banlat Agricultural Cooperative (BAC) and the Pan Pacific Food Corporation (PPFC). The initiation of the contract until complete implementation of the terms usually follows the following steps:

Step 1: Project Announcement

Once BAC validates the feasibility of a project site, this is announced by BAC and PPFC field personnel to the individual farmers in the target site.

Step 2: Technical Training and Other Project Details

BAC arranges a members' meeting to present more details on the project of exporting Gros Michel bananas to Japan. Technical information on growing chemical-free banana, management of the orchard, harvesting, grading, cleaning, and packaging are also discussed. The marketing arrangement is also presented along with the price offer, followed by a thorough question-and-answer session between BAC, the PPFC, and the farmers.

Step 3: Study Tour and Experiment Plots

To gain more confidence in banana growing, a study tour is arranged to the Lamae Banana Growers' Group in Chumporn Province. The group has been exporting bananas to Japan since 1991. The farmers gain some firsthand insights on banana exporting from the experiences of the farmers who have actually been doing it for a long period of time.

Parallel to this, pilot plots are constructed to allow representatives from each area to perform various experiments on banana growing. Lessons

learnt from pilot plots provide valuable guidance for all members in the actual cultivation of bananas.

There is a values orientation among the farmers on strict adherence to organic farming. Use of any form of chemical product is strictly prohibited. Intercropping with any crop that may require chemicals (e.g., lemon, eggplant, chilies) should be completely avoided.

Step 4: Membership in BAC

It is necessary that eligible farmers who wish to participate in the project are members of BAC. BAC serves as the liaison between the PPFC and the farmers. BAC will also ensure that the farmers clearly understand the rules and regulations of chemical-free banana growing. With membership in BAC, farmers allow BAC to deduct a percentage from the sales of the produce as their contribution to the mutual welfare fund.

The assessment of farmers' qualifications includes a visit by BAC personnel to their farm plot. Termination of membership in BAC occurs when the farmer resigns voluntarily, when the farmer does not own a farm plot for 1 year, and when no banana deliveries to BAC are made for 1.5 years.

Step 5: Start of Cultivation

The farmer will have to inform the field staff of BAC on the planned quantity of bananas to be grown. This will be recorded and will help BAC in projecting the volume of output and hence facilitate the management of their trade. It is approximated that in the period of 1 month 8,000–10,000 shoots of banana planted can produce enough quantity for a shipment every week for the group.

Step 6: Facilities for Collecting, Grading, and Packaging

BAC invests in the infrastructure and equipment needed for the hauling and packaging process. The expenses for the air-conditioned container are equally shared between BAC and the PPFC. A provincial development fund was used in the construction of the packinghouse building. BAC is responsible for the management and cost of labor during the harvesting and packaging process, while the PPFC supports the cost of some materials for packaging.

Step 7: Field Audit

To ensure strict adherence of members to the rules and regulations, field visits by the BAC or PPFC staff are made 1–2 times a month. Group meetings at the farm are sometimes arranged for the exchange of experiences and information among members and the staff of BAC and the PPFC.

Step 8: Harvesting

The BAC and the PPFC are responsible for harvesting, transporting, and packaging the bananas. The growing data of bananas by each farmer are recorded by BAC and the PPFC who closely monitor the growth and final schedules for the harvesting of the crop later on. From the shoot, it will take 270–280 days to harvest the fruit. After harvesting, the bananas have to be packed within 4 hours and be kept in an air-conditioned container to preserve the quality. BAC has set the schedule for harvesting and packing for Thursday and Friday of each week.

Step 9: Payment Scheme

BAC acts as the intermediary between banana growers and the PPFC who is the exporter. Every Monday, BAC pays in cash to all farmers for their produce. The on-time payment is considered one important factor for the sustainability of the group.

Appendix 5 Roles of Actors in the Case Study

The terms of Banlat Banana Contract Farming stipulate the roles of the different contracting parties: the farmers' group as the banana grower, the Banlat Agricultural Cooperative (BAC) as the collector, the Pan Pacific Food Corporation (PPFC) as the exporter, and the Shutoken Consumers' Cooperative (SCC) as the consumer/importer. The following are summaries of the contract terms for each party:

Role of Banlat Agricultural Cooperative

Serving as the intermediary between the farmers and the exporter (PPFC), the role of BAC is to:

- (i) initiate the project with PPFC;
- (ii) organize members' meetings and ensure a reasonable size of membership for the group's sustainability and continuous production volume;
- (iii) manage the registry of members (including production dates) and do all the paperwork;
- (iv) provide funds/assistance from external sources for physical investments, such as a packinghouse;
- (v) invest in packaging equipment and machines and share in costs of air-conditioned banana containers;
- (vi) plan and supervise fields and perform crop audits;
- (vii) perform harvesting, transporting, grading, and packaging of the produce as scheduled and in a manner that meets export standards; and
- (viii) act as an intermediary, buying bananas from farmers and then processing them for turnover to the PPFC for export.

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continued

BAC buys all bananas from the members' orchards and pays all farmers 2 days after harvesting. BAC will receive payment from the PPFC 4 days later. After harvesting and transporting the bananas to BAC's packinghouse but before turning over the bananas to the PPFC, BAC (i) divides bunches and classifies bananas into grades, (ii) examines the color of the banana meat (which indicates sweetness and gestation period for ripening), (iii) cleans the bananas with natural soap and blow dries them, (iv) checks for insects, (v) packs and weighs bananas, and (vi) stores bananas in temperature-controlled containers until shipment to Japan.

Role of the Pan Pacific Food Corporation (PPFC)

While BAC is the collector of produce to accumulate volume, the PPFC is the trader who exports bananas to Japan. The PPFC performs the following tasks as stipulated in the contract farming agreement:

- (i) announce projects to farmers in target sites with BAC staff;
- (ii) arrange study tours for BAC farmers to the Lamae Banana Growers' Group in Chumphon Province;
- (iii) invest in air-conditioned containers along with BAC;
- (iv) supervise farmers, visit fields, and audit production systems;
- (v) compile BAC farmers' reports on banana production, estimate monthly output, and coordinate with the Shutoken Consumers' Cooperative in Japan to safeguard the supply-demand equilibrium;
- (vi) contribute one-third of the cost of harvesting and transporting bananas from the farm to the BAC packinghouse;
- (vii) provide foam, sponge sheets, boxes, and other materials for the harvesting and packaging; and
- (viii) offer additional assistance to farmers in times of natural calamities.

Role of Shutoken Consumers' Cooperative (SCC)

The SCC has created new dimensions to the producer-consumer relationship that strengthened ties with banana growers and reduced supervision costs. The SCC offers (i) seed money of 1 million baht to provide credit to BAC members for 20 months, interest-free (each BAC member can obtain a credit of 7,000–20,000 baht per rai.); (ii) contributions to the welfare fund (Japanese consumers contribute 1 baht per kilo of bananas purchased, while BAC members give 50 satangs per 100 baht of sales value. The welfare fund is used as form of incentive for BAC farmers in times of natural calamities. The fund functions as a unique form of crop insurance. When crops are destroyed, the farmers will get compensation equivalent to 50% of the last total sales. This system fosters respect and appreciation of farmers for their consumers and can reduce the cost of supervision by the consumers.); and (iii) promotion of visits between Japanese consumers and Thai banana growers (Visits of Thai farmers to Japan are supported by the SCC. Their visits to Japan made them understand more about demand fluctuation, implications of errors in timing of harvest resulting in rotten bananas, etc. Exchange visits attract farmers to join BAC and be part of banana contract farming).

Appendix 6 Contract Farming in Thailand

Under the national development plan (1987–1992), contract farming was recognized by the Government of Thailand as an important development strategy for development of agriculture and agroindustry. Under the plan, the government established a coordinating committee to develop a partnership among four sectors—the government, the private sector, financial institutions, and farmers—to help improve productivity and income of farmers, as well as to build up resources for the expanding export of agricultural commodities. The committee is also tasked with resolving any conflicts that may occur in contract farming. In subsequent national plans, contract farming remains a development tool for the sector with some modifications of the supporting features, i.e., instead of shouldering the interest payment for farmers' credit, credit with low interest rates was provided. The mechanisms of contract farming were also adjusted so that it is easier and more appropriate for all parties joining the contract.

Under the Fourth National Plan 1987–1992, several projects based on the joint cooperation between the government, the private sector, financial institutions, and farmers materialized. The projects covered maize, sorghum, basmati rice, castor bean, sunflower, cashew nut, wheat, barley, asparagus, and bamboo shoot. There were about 200,000 farming households involved, with a total produced value of 4,014.4 million baht. The results of the projects were mixed. Several farmers who joined the project became heavily indebted, even resulting in loss of their land for some. Reasons for the failure were noted, including the lack of knowledge on appropriate practice of farmers on a particular crop; lack of research and development on specific crops, sometimes introducing it to unsuitable areas; poor quality of inputs supplied by the private sector or by the government, resulting in low-quality produce consequently affecting marketing viability as well as the farmers' financial burden; lack of market access; and unstable prices.

Many contract farming projects were proposed by the private sector later during 1993–1996, including fast-growing trees, cash crop, silkworms, etc. Some failures or inadequate participation among these projects were noted because of lack of transparency on the fair benefits among the stakeholders. The farmers were specifically disadvantaged since there was no risk guarantee shielding them within the contract. This prompted the government to review the collaboration plan among the four sectors and to implement appropriate measures to truly push agricultural development.

The thrust of the coordinating committee shifted in October 1996 to endorse the change from contract farming to cost-sharing market. The idea is to encourage investments from the private sector to increase the guarantee among risk-taking farmers that had previously been overlooked in the contract farming engagement. There are five important features in this cost-sharing approach:

- (i) The private sector invests by lending inputs to provide credit without interest for an amount not to exceed 5% of the total production cost of each round and no less than 5% of the credit provided by the government. Farmers will pay back after harvest.
- (ii) The private sector will arrange for the guarantee letter by the commercial banks or will deposit money in the financial institutions as a guarantee amounting to no less than 10% of the amount of produce in each crop. This serves as a guarantee for the loans used by the farmers to procure quality inputs.
- (iii) The welfare fund will be set up for the farmers to be used in case of natural disaster or any emergency situations.
- (iv) Coordination will be made with other financial institutions aside from the Bank for Agriculture and Agricultural Cooperatives to raise fund. The government provides the budget to subsidize interest payments and to manage loans.
- (v) Target areas and farmers will be identified to join in the project and provided with expert advice. There is a subsequent monitoring and evaluation of the production performance among farmers by representatives from the government and the private sector.

Conditions of the cost-sharing project were too tough for the private sector that no firm wanted to participate. The 1997 economic crisis further complicated the problem (no budget support from the government) leading to the eventual termination of the coordinating committee and the institutional support.

Most of the prevailing contract farming arrangements are formed between a private company and a farmer or farmers' group. The patterns and terms of the agreement usually vary from one commodity to another. The following are the general characteristics of the current contract farming terms:

- (i) The contracting parties (processing factories, exporters, traders, or buying agents) usually assess qualifications and suitability of farmers, farmers' groups, or farmers' organizations. The common qualification criteria include viability of production area and quantity of production. A representative is usually sent to survey and/or

investigate prospective farmers or farmers' groups to ensure that they are capable of fulfilling the possible agreement terms.

- (ii) The contractor usually provides or facilitates the procurement of productions inputs. The assistance may also include training on production technologies as well as postharvest handling of produce.
- (iii) The contract period varies according to cultivation season and the commodities involved. The contracting parties mutually agree on the duration from less than 1 year to multiple-year contract periods.

The contract agreements for buyers and sellers focus on marketing issues, such as pricing, volume, quality, and turnover days. Some agreements include procurement of production inputs, while others give importance to managing the production system. Agreement can usually be in one of the two following forms:

- (i) **Vertical integration.** The agreement is made between an individual farmer and the packinghouse, exporter, trader, or the local buying agent for a more complete and integrated business arrangement from preproduction to postharvest handling. This contract type is very common in chicken meat, palm oil, pineapples, etc.
- (ii) **Horizontal integration.** The agreement made between a farmer group and the packinghouse, exporter, trader, or other business agent who may also group together for the purpose of increasing their bargaining power. This type of contract is used in industrial crops, such as sugar, where good prices are easily fetched from the international market if there is accumulated volume of the commodity ready for shipment.

Not all crops may be suitable to be the subject of a contract farming agreement. Certain features of contract farming may work only in the following cases:

- (i) Easily perishable commodities, such as vegetables and fruits, that must be timely distributed to consumers or manufacturers.
- (ii) Commodities with complex growing stages or processing systems or that are labor-intensive, such as tobacco, tea, and cattle.
- (iii) Commodities that require expensive, multi-user processing equipment, such as palm oil, sugar cane, and rubber.
- (iv) Commodities for which the market has specific quality requirements, such as basmati rice, seedlings, and cattle.

The Internal Trade Department of the Ministry of Commerce identified the following factors that can lead to the success of contract farming:

- (i) Relevant private and government agents must understand the true principles and methods of contract farming. The promotion and development of contract farming should feature the potential benefits that the different stakeholder can realize.
- (ii) Buyers and sellers must share information related to crop production and marketing of the commodity.
- (iii) Buyers and sellers have substantial capital for a sustainable operation of the production and marketing chains.
- (iv) Input sources and the processing factories must not be too far away from the production area to minimize the cost and damage from transportation.
- (v) For sustainability, buyers and producers can keep the following practices in mind:
 - a. Buyers and producers must cooperate and share experiences and lessons learned from contract farming with other prospective participants.
 - b. Sellers/producers must strictly observe the timelines, quantity, and quality stipulated in the contract.
 - c. Buyers must be fair to sellers in terms of clear inspection, rapid weighing process, and confidence in payment.
 - d. The government sector should support and give special assistance in the areas of technological information, production inputs, credit facilities, etc. to the parties who join the contract farming arrangement.

Glossary

agribusiness: businesses involved in agriculturally related production systems, such as crop production, including farming and contract farming, seed supply, agrichemicals, farm machinery, wholesale and distribution, processing, marketing, and retail sales.

agroprocessing industry: defined as the industry involved in technoeconomic activities, applied to all the produce originating from agricultural farm for their conservation, handling and value addition to make them usable as food, feed, fiber, fuel, or industrial raw materials.

agroservices: services needed by farmers in agricultural production, which include extension and training (soil preparation, farm management, crop cultivation, and disease control), access to credit and markets, organization of farmers' groups, and basic infrastructure (irrigation and farm feeder roads).

Ayeyawady–Chao Phraya–Mekong Economic Cooperation Strategy (ACMECS): a cooperation framework amongst Cambodia, the Lao People's Democratic Republic, Myanmar, Thailand, and Viet Nam to utilize member countries' diverse strengths and to promote balanced development in the subregion established in 2003.

certification: procedure by which a third party gives written assurance that a clearly identified process has been methodically assessed, such that adequate confidence is provided that specified products conform to specified requirements (International Federation of Organic Agriculture Movement [IFOAM]).

Codex Alimentarius: collection of international food standards, guidelines, and codes of practice that contribute to the safety, quality, and fairness of international food trade. It is recognized by the World Trade Organization as an international reference point for the resolution of disputes concerning food safety and consumer protection. Its texts are developed and maintained by the *Codex Alimentarius* Commission, a body that was established in early November 1961 by the Food and Agriculture Organization of the United Nations (FAO), was joined by the World Health Organization (WHO) in June 1962, and held its first session in Rome in October 1963. (<http://www.codexalimentarius.org/>)

Community-supported agriculture (CSA): defined as a direct marketing partnership between a farmer or farmers and a committed network of community supporters/consumers who help to provide a portion of a given farm's operating budget by purchasing "shares" of the season's harvest in advance of the growing season. CSA shareholders make a commitment to support the farm financially (and/or through other roles) throughout the growing season, thereby assuming some of the costs and risks along with the grower.

contract farming: defined as arrangements whereby development assistance or agriservices are provided to farmer that could include improved farming practices, provision of extension services, quality control mechanisms, and access to credit and market for products. The definition of contract farming excludes informal contracts between local traders and farmers without provision of technical assistance and quality improvement.

conventional: denotes any material, production, or processing practice that is not certified organic or organic "in-conversion" (IFOAM).

corporate social responsibility (CSR): defined as the continuing commitment by business to behave ethically and contribute to economic development while improving the quality of life of the workforce and families as well as of the local community and society at large.

endogenous switching regression model: a statistical model for joint determination of a discrete variables, and the outcome that they affect.

Good Agricultural Practices (GAP): practices that address environmental, economic, and social sustainability for on-farm processes, and result in safe and quality food and non-food agricultural products (Food and Agriculture Organization COAG 2003).

Good Manufacturing Practices (GMP): system for ensuring that products are consistently produced and controlled according to quality standards appropriate to their intended use and as required by the product specification (World Trade Organization[WTO]).

Greater Mekong Subregion (GMS): geographical area covered by the Asian Development Bank for regional cooperation and integration in Southeast Asia composed of Cambodia, Yunnan Province and Guangxi Zhuang Autonomous Region of the People's Republic of China, the Lao People's Democratic Republic, Myanmar, Thailand, and Viet Nam.

Hazard Analysis at Critical Control Points (HACCP): management system in which food safety is addressed through the analysis and control of biological, chemical, and physical hazards from raw material production, procurement, and handling, to manufacturing, distribution, and consumption of the finished product (US Food and Drug Administration)

International Federation of Organic Agriculture Movements (IFOAM) Basic Standards (IBS): provides a framework rooted in IFOAM's Principles of Organic Agriculture, for certification bodies and standard-setting organizations worldwide to develop their own certification standards and cannot be used for certification on their own. It addresses the specific principles, recommendations, and required baseline standards that guide operators in producing their organic crops and maintaining organic integrity in the further handling and processing of organic commodities.

International Organization for Standardization (ISO): world's largest developer of voluntary international standards. International standards give state-of-the-art specifications for products, services, and good practices, helping to make industry more efficient and effective. Developed through global consensus, they help to break down barriers to international trade.

Japanese Agricultural Standard (JAS): standards for quality and production methods for foods, beverages (excluding alcoholic drinks), and forestry products in Japan. JAS is not a standard on food safety, HACCP, or GAP. JAS logos are used on packages of products graded by producers, manufacturers, distributors, or importers that are certified by a third-party organization (Ministry of Agriculture, Forestry and Fisheries; Government of Japan).

Millennium Development Goals (MDGs): eight international development goals agreed by all the world's countries and leading development institutions following the Millennium Summit of the United Nations in 2000. They range from halving extreme poverty rates to halting the spread of HIV/AIDS and providing universal primary education by 2015.

monocropping: practice of cultivating one crop year after year on the same land, in the absence of rotation through other crops. High-yielding crops such as corn, soybeans, and wheat are commonly grown.

noncontract farming: plant and crop cultivation done by independent farmers solely responsible for their production practices without receiving any assistance from potential buyers. The farmers are free, in principle, to sell their produce to any interested buyer at the prevailing market rates.

organic agriculture: defined as a “production system that sustains the health of soils, ecosystems and people.” It relies on ecological processes, biodiversity, and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation, and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved (IFOAM).

profit efficiency: defined as the ratio of the observed profit to the potential maximum attainable profit.

propensity score matching(PSM) method: statistical matching technique that attempts to reduce the bias due to confounding factors in an estimate of the treatment effect obtained from simply comparing outcomes among units that received the treatment versus to those that did not. The PSM technique was first published by Paul Rosenbaum and Donald Rubin in 1983.

regional cooperation: process in which countries in an ADB-defined region or subregion, or in Asia and the Pacific work together to address common concerns.

regional integration: process through which countries in an ADB-defined region or subregion, or in Asia and the Pacific become more interconnected and interdependent.

sanitary and phytosanitary (SPS) measures: measures taken to protect against risks linked to food safety, animal health, and plant protection, or to prevent or limit damage within the territory of a WTO member from the entry, establishment, and spread of pests (WTO).

teikei system: alternative distribution system that does not depend on conventional market for organic food used by producers and consumers committed to a particular set of social and agricultural principles developed in Japan which started the organic movement.

toxic agrochemicals: chemicals used in agricultural production (such as pesticides and fertilizers) that cause severe health or environmental effects when used. Formulations included ichlorodiphenyltrichloroethane

(DDT), polychlorinated biphenyls (PCBs), and mercury which may cause disability, birth defects, and even death.

traceability systems: tools that enable producers and consumers to follow an item or group of items (animal, plant, food product, or ingredient) from one point in the supply chain to another. In Canada, a *national livestock traceability system* is based on three pillars: animal identification, premises identification, and animal movement (National Agriculture and Food Traceability System). In the *fresh produce industry* in the United States, the development of traceability systems has been greatly influenced by perishability of and quality variation in produce that requires boxing and identification of quality attributes early in the supply chain, either in the field or packinghouse. This has facilitated the establishment of traceability for a number of objectives including marketing, food safety, supply-side management, and differentiation of new quality attributes (US Department of Agriculture, Economic Research Service Traceability in the US Food Supply).

vertical integration: combination in a company of two or more stages of production normally operated by separate companies.

Index

A

agribusiness 4, 9, 71, 231, 241, 264, 276
Agricultural Promotion Bank (APB) 115, 118
Agriculture Certification Thailand (ACT) 242
agroprocessing industry 6, 20
agroservices 3, 74
Angkor Kasekam Roongroeung (AKR) 134–140, 142, 146, 147, 153, 159, 161, 162
ASEAN Free Trade Area (AFTA) 112
Asian Development Bank (ADB) 16, 22, 44
Asian Development Bank Institute (ADBI) 16, 23, 134, 242, 244–245, 247–249, 267, 268, 269–270, 282–283, 286, 289, 290–291, 297
Association of Southeast Asian Nations (ASEAN) 112, 175, 182, 186, 267
Ayeyawady–Chao Phraya–Mekong Economic Cooperation Strategy (ACMECS) 18–19, 22, 30, 36, 44, 48, 112

B

Bank for Agriculture and Agricultural Cooperatives (BAAC) 28, 34–35, 283–284, 311, 326
Banlat Agricultural Cooperatives (BAC) 300, 303–308, 321–324
Basic Standards (IBS) 299
Board of Investment (BOI) 239

C

Cai, Junning 53, 71, 133, 273
Cambodia 3–4, 17, 18–19, 36, 67, 71–72, 95, 110, 112, 133–134, 136, 140, 161, 191, 232, 242–243, 245, 247–253, 255, 260, 267–268, 270, 293
certification 12, 36, 53, 74, 75, 80, 101, 134, 173, 177, 184–185, 187, 189, 191, 193, 198, 209, 2013–214, 222, 224, 235, 239, 246–249, 252, 253, 254, 255, 257, 261, 269, 299, 302, 305, 317, 318
China, the People's Republic of 17, 30, 67, 71, 112, 174–175, 189, 216, 232, 237, 239, 244–245, 247–248, 252, 268–270, 274

Codex Alimentarius 43, 175, 185, 187, 205, 263, 299
 Committee on Sustainability Assessment (COSA) 193, 198
 community-supported agriculture (CSA) 16
 contract farming 1, 3–4, 6, 15, 19, 27, 37, 51, 71–74, 109, 133, 231, 271, 273, 275, 276, 297, 299, 307, 321, 323, 325
 conventional farming 7, 317
 corporate social responsibility 15, 16

E

endogenous switching regression model 59, 64, 67, 68, 124, 126, 154, 316
 European Retailers Group (EUREP) 182, 186, 195
 European Union (EU) 43, 173, 175, 191, 208, 212, 242

F

Fairtrade Labeling Organizations International (FLO) 184, 187
 Food and Agriculture Organization (FAO) 185, 187
 Food Marketing Research & Information Center (FMRIC) 214, 216–219
 Food Safety Commission (FSC) 234–235
 foreign direct investment 110, 127, 179, 257
 free trade agreements 206, 253–254
 Free Trade Area 112
 fresh fruit and vegetables 190

G

genetically modified organism 173, 174, 242
 Giovannucci, Daniele 171
 global positioning system (GPS) 210–211
 good agricultural practices 43
 Good Agricultural Practices 177, 206, 254, 281, 299
 good animal husbandry practice 43
 Good Manufacturing Practices (GMP) 182, 186, 206, 254
 Greater Mekong Subregion (GMS) 3–4, 19–22, 34, 36, 44, 253
 gross domestic product 109, 133, 174

H

Hazard Analysis and Critical Control Points (HACCP) 43, 173, 174, 182, 185–186, 205–206, 208, 239, 254
 hectare 34, 36, 39, 42, 115–121, 123–124, 133, 137, 141–144, 146–147, 150–155, 162, 274

I

Information and Communication Technology (ICT) 205, 210–211, 215–216, 220–221
 Institute of Grocery Distribution (IGD) 176–179, 200
 International Center for Tropical Agriculture (CIAT) 198
 International Committee of Food Retail Chains (CIES) 187
 International Federation of Organic Agriculture Movements

(IFOAM) 182, 187, 242, 262, 269, 299

International Food Policy
Research Institute (IFRI) 177,
198, 200, 202

International Fund for Agricultural
Development (IFAD) 191

International Organization
for Standardization 174, 185,
205, 239

International Organization for
Standardization (ISO) 174, 185,
205, 239

International Plant Protection
Convention (IPPC) 187

International Social and
Environmental Accreditation
and Labeling (ISEAL) 187

J

Japanese Agricultural Standards
(JAS) 213, 235, 236–237, 248,
269, 299

Japan External Trade Organization
(JETRO) 232, 238, 239–242, 256

Japan Organic Agriculture
Association (JOAA) 300

K

kilogram 33, 41, 42, 85–87, 96–97,
101, 119–121, 123, 141–144, 146–
148, 150–154, 218–219, 274, 286–
287, 288–289, 291, 296, 312–313,
314–316

kilometer 112, 134

L

Lao Agro Industry Co. (LAI) 110
Lao People's Democratic Republic
3, 4, 17–19, 36, 71–72, 95, 109–112,

114–115, 118, 126, 130, 133, 191,
232, 242–243, 244–247, 248–253,
255, 267, 268–270, 293

Leung, PingSun 53, 71, 109, 133,
273, 299

M

Maximum Residue Levels 173

Mekong Private Sector
Development Facility (MPDF)
109, 111–112, 128

microfinance institution 138–139,
141

Millennium Development Goals
(MDGs) 3, 22

Ministry of Agriculture and
Cooperatives (MOAC) 27, 47,
48, 72, 78, 274, 281, 303

Ministry of Agriculture, Forestry
and Fisheries (MAFF) 209,
236–237

multinational corporations
(MNC) 10

Munjaiton, Tangon 273, 299

Myanmar 3, 18, 19, 36, 112

N

National Association of
Vietnamese Gardeners
(VACVINA) 241

National Biotechnology Center
(BIOTEC) 42

National Economic and
Social Development Board 19,
27, 47

New Economic Mechanism
(NEM) 109

new institutional economics 4

noncontract farming 42–43, 54, 72,
83, 88–89, 92, 115, 126

nongovernment organizations
(NGOs) 57, 113, 183, 239
North American Free Trade
Agreement (NAFTA) 179

O

Office International des Epizooties
(OIE) 187
official development assistance 115
Organic Agriculture 72, 74, 182,
187, 199–200, 202, 239, 242, 260,
269, 299, 300

P

Pan Pacific Food Corporation
(PPFC) 303–304, 306–308, 321,
323–324
profit efficiency 16, 72, 75–77, 83,
89, 90–95
propensity score matching method
59, 60–61, 110, 122–123, 126, 148,
289, 291, 309, 316
Purcell, Timothy 171

R

radio frequency identification 210,
265
Regional Cooperation 1, 3

S

Sakai, Jun 205
sanitary and phytosanitary 186,
205, 275
Setboonsarng, Sununtar 3, 71, 109,
133, 205, 231, 299
Shutoken Consumers Cooperative
(SCC) 300, 303–304, 306, 308
small and medium-sized
enterprises 112, 177

Socio-Economic Development
Strategy (SEDS) 240
Sriboonchitta, Songsak 27
State Enterprise and Food Crop
Promotion (SEFCP) 111
Stefan, Adam 109
sufficient processing threshold
(SPT) 206

T

Technical Barriers to Trade (TBT)
186, 187, 232
teikei system 16, 299–302
Thailand 7–10, 12–13, 16, 17–19, 27,
30–35, 39, 41–44, 46, 67, 71–72, 75,
78, 83, 87, 90, 94–95, 98, 110, 112,
115, 175, 180, 189, 232, 238–239,
242–243, 244–252, 254–257,
268–270, 273–278, 281, 292–293,
299–300, 302–303, 304, 308–309,
316–317, 325
Thailand Research Fund (TRF) 42
toxic agrochemicals 231
traceability systems 8, 10, 74–75,
172, 177, 205, 207, 210–216, 226–
227, 229, 235–237, 257, 263–264,
266, 299

U

Ung, Luyna 133
US Department of Agriculture 175

V

Vancura, Lucia 201
vertical integration 5, 18, 231
Viet Nam 17–19, 36, 49, 110, 112,
133, 140, 175, 180, 195, 232,
240–241, 243, 245–252, 255–257,
268–270

W

- Wiboonpoongse, Aree 27
- World Health Organization (WHO)
185
- World Trade Organization (WTO)
171, 186–187, 205, 232

Making Globalization Work Better for the Poor through Contract Farming

The changing structure of agricultural trade in a globalizing world has become an integral part of effective rural development. In this context, contract farming has emerged as a promising rural development strategy that has gained momentum in the region, providing technical training, production inputs, and market linkages to smallholders. Contractors, often multinational agribusiness companies, in turn benefit from a steady supply of consistent quality produce. This volume shows that the practice of contract farming has been improving lives in rural areas in various parts of Asia, especially of small-scale farmers who now have assured markets for their produce. Contract farming is also evolving and now comes in modified forms to better address the needs and capacities of all parties involved. Its service of linking producers and markets, however, remains unchanged, along with the gains it brings to smallholder producers, agribusiness firms, and eventually consumers.

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