The Competitiveness of the Sugar Industry in Thailand

Dissertation
Zur Erlangung des Grades eines Doktors der Agarwissenschaften vorgelegt
der Fakultät Agrarwissenschaften

Von
Wuttipong Arjchariyaartong
Aus Ubonratchatani, Thailand
2006
PREFACE

Thailand ranks third among sugar cane exporters in the world market, next to Brazil and Australia, and it has a great contribution to its national income. For this reason, sugar cane production is one of the major economic sectors in Thailand. There are several activities involved in the production process such as sugarcane growing, sugar milling, credit banking, exportation, etc. The sugar production activities provide significant full time and temporary employment in sugar factories, sugar transformation, transportation and exports. Therefore, the study of sugar cane and sugar industry’s competitiveness is important, especially with the increasing liberalization of the world market and agricultural trade.

In this volume Wuttipong Arjchariyaartong assesses the competitiveness of the sugar industry in Thailand. The analysis deals with the structure of sugarcane and sugar production, costs and returns of sugarcane farms, sugar industry and competing crops. It dwells on the competitiveness of the sugar industry and identifies indicators of competitiveness. Finally, strategies of sugar cane growers and sugar factories for improving competitiveness in the future are examined.

The analysis of profitability of sugarcane production has shown that the highest profit is achieved in the Central region. The comparison of sugarcane and its competing crops has shown that there are four main competing crops of sugarcane, which are, rice, pineapple, cassava and maize. The sugar industry has high crushing capacities, but it could suffer from increasing wages in future because of low labor productivity.

The research concludes that sugarcane is still the key crop for sugarcane farmers in Thailand because the secondary crops can not be perfect substitutes.

This study and field research were funded by the Royal Thai Government Scholarship; their support is gratefully acknowledged.

Prof. Dr. Drs. h.c. Jürgen Zeddies
University of Hohenheim
Stuttgart, Germany
ACKNOWLEDGEMENTS

First and foremost, I would like to express a special thank to Prof. Dr. Drs. h.c Jürgen Zeddies for his great help in commenting the drafts of this thesis and his readiness to serve in the evaluation committee of my dissertation. I would like to express my sincere gratitude to Dr. Beate Zimmermann for her help, guideline, encouragement and recommendation. Thanks to Prof. Dr. Dr. h.c. Franz Heidhues and Prof. Dr. Manfred Zeller for serving on my examination committee. I would like to thank Dr. Frank-Michael Litzka for his help in computer technique and very nice greeting all the time.

Furthermore, I would like to thank the Royal Thai government scholarship very much for the support and grant to finance my doctorate studies at the University of Hohenheim, Stuttgart, in Germany. Thereafter, I would like to thank Dr. Chaw Wayoopagtr to support me to study in Germany.

I would like to thank very much all sugarcane farmers, sugar factories, sugarcane experts, the Sugarcane Farmer Association, the Office of the Cane and Sugar Board, and the Office of Agricultural Economics in Thailand for their goodness to give me the opportunity for interviews and also to support me with information.

I would like to extend my thanks to Erin and Deane Shephard who helped me, criticized and improved my work and presentation. Moreover, I thank Michael and Akiko Fischer for their assistance in several computer techniques. I would like to express my thanks to the staff members and friends at the Department of Farm Management (Institute 410b), University of Hohenheim, for their support. Special thanks go to Ursula Held for her assistance in all administrative processes and moral support during my study. My special thanks go to Thitiwan Sricharoen who has been getting along with me from the beginning and her never ending attempts to help me solving difficulties.

Finally, I am indebted to my family and relatives for keeping in touch with me and their manifold supports.

Wuttipong Arjchariyaartong
University of Hohenheim
EXECUTIVE SUMMARY

Thailand is now firmly established as one of the world’s leading sugar exporting countries. During 1995/96 to 2005/06, sugar exports ranged between 2.3 and 5.1 million tons and averaged 3.80 million tons per year. For this reason, sugar cane production is one of the major economic sectors in Thailand. There are several activities involved in the production process such as sugarcane growing, sugar milling, credit banking, exportation, etc. The sugar production activities provide significant full time and temporary employment in sugar factories, sugar transformation, transportation and exports. Therefore, the study of sugar cane and sugar industry’s competitiveness is important, especially with the increasing liberalisation of the world market.

The overall objectives of this research are to analyse the competitiveness of the sugar industry in Thailand. This thesis combines an in-depth sugarcane farm and sugar industry survey with a qualitative and quantitative data analysis. Based on the above considerations, this thesis has key objectives as follows:

1. To study the structure of sugarcane and sugar production in Thailand
2. To analyse costs and returns of sugarcane and sugar production in Thailand.
3. To examine the competitiveness of the sugar industry and identify indicators of competitiveness.
4. To describe strategies of sugarcane growers and sugar factories for improving competitiveness.

This study focuses on comparing the costs and returns between sugarcane and its competing crops in Thailand. Field surveys and interviews have been carried out with people involved in sugarcane production activities. Additional secondary data were reviewed to support the research. The data source used in this study consists of both primary and secondary data. The primary data was collected by the use of questionnaires, which were divided into farm and industry questionnaires. Data was collected in the crop year of 2003/04. The analysis of secondary data used the data from 1982 to 2006. This research work was conducted in Central, Northeastern and Northern Thailand. The study area consists of 9 provinces in 3 regions.

Firstly, the structure of sugar cane production in Thailand can be described as follows. The total cane area amounted to 6.34 million rai (1.01 million hectare) in 2004/05. The most important regions of sugar cane production are the Northeastern, the Central and the Northern region. The total cane production amounted to 47.82 million tons in 2004/05 with an average yield of 7.54 tons/rai (47.13 ton/ha). More than 80% of the total number of sugar cane growers in Thailand (174,326) is small farms with less than 59 rai (9.44 hectare) of sugar cane area. 87% of the cane growers produce under rainfed conditions; only 13% are irrigating their sugar cane area.

Secondly, the structure of the sugar industry in Thailand can be described as follows. Within the total number of 46 sugar factories, there are 4 large factories with crushing capacity of more than 24,000 tons of cane crushed per day, 16 medium size factories (12,000-24,000 tons/day) and 26 small size factories (< 12,000 tons/day).

Thirdly, the sugar market in Thailand can be described as follows. The total sugar production amounted to 7 million tons in 2003/04. With a share of domestic consumption of 27.8% only around 2 million tons of sugar is used for domestic consumption. The rest of around 5 million tons of sugar is exported to the world market, mostly to Asia. The wholesale prices for the domestic market are annually fixed by the government to around 12 Baht/kg in the average.
Fourthly, the result of sugarcane farms can be concluded as follows. The analysis of sugarcane costs of production has shown that the total production costs of sugarcane farms for the first ratoon are highest and decrease in the second and third ratoon. The farms in the Central region have higher production costs (4,245 Baht/rai) than the cane growers in the Northeast (4,130 Baht/rai) and in the North (3,725 Baht/rai). The analysis of total revenues of sugarcane production has shown that on average, sugarcane farmers benefit a lot from investing in the first ratoon (around 5,589 Baht per rai). However, the revenue decreases with the declining yield, especially in the third ratoon. The analysis of profitability of sugarcane production has shown that the average total profit of sugarcane farms over all regions in the second and third ratoon let sugarcane farmers get the highest profit of more than 2,000 Baht per rai, while sugarcane planting in the first ratoon gives farmers less profit (208 Baht per rai). The analysis of break-even yield and break-even price indicated that the average break-even yield for the third ratoon of sugarcane production is the lowest with 6.1 tons/rai. This means that sugarcane farmers would already reach the break-even point for recovering all costs if they only produce 6.1 tons/rai. The break-even price analysis shows that the break-even price decreases with every ratoon. The comparison of gross margins of sugarcane production shows that the average gross margin in the first ratoon (769 Baht/rai) is much lower than in other ratoons. The comparison of sugarcane production and competing crops has shown that there are four main competing crops of sugarcane, which are, rice, pineapple, cassava and maize. However, they are no perfect substitutes because of natural and market conditions.

Fifthly, the results of the sugar factory analysis can be concluded as follows. The five investigated factories are one large factory with a crushing capacity of more than 23,000 ton of cane per day, and four small factories with a cane crushing capacity of less than 12,000 ton/day. Although most of the cane suppliers are small size farmers, the majority of cane comes from medium and large farms. The productivity analysis of the sugar industry shows that factory C possesses an advantage with respect to the quantities of total sugar production per rai in production year 2002/03 and 2003/04. The analysis of extraction rate of sugar per ton of sugarcane found that the average extraction rate of the investigated factories are about 96.68 kg of sugar/ton of sugarcane in the production year 2002/03 and increased to 106.72 Kg of sugar/ton of sugarcane in the production year 2003/04. The analysis of sugar production costs shows that the average variable costs of sugar production amounted to 9.41 Baht/kg in 2002/03 and declined to 8.27 Baht/kg in 2003/04. The profitability analysis of sugar production shows that sugar producers made an average profit of sugar production of 0.21 Baht/kg in production year 2002/03. Then, the average profit of sugar production increased to 0.45 Baht/kg in production year 2003/04.

Finally, this study provides suggestions and policy recommendations for sugarcane farms and sugar factories in four areas. First, sugarcane productivity per rai is still low in Thailand, therefore research and development is necessary in the field of optimization of the production process and the breeding of new sugarcane varieties. Second, enough water and access to irrigation system is very important for sugarcane planting, so the government should help to provide these facilities for the farmers. Third, the sugar industry should differentiate their sugar products in order to increase the value added of sugar production. This will help sugar factories in case of encountering the situation of low prices of sugar. Fourth, due to increasing energy costs, sugar factories should get support in acquiring alternative energies and reducing other cost of production by research and development.

1 Ratoon is the shoot sprouting from a plant base, as in the sugar cane.
# TABLE OF CONTENTS

PREFACE...................................................................................................................viii
ACKNOWLEDGEMENTS..........................................................................................ix
EXECUTIVE SUMMARY..........................................................................................xi
TABLE OF CONTENTS............................................................................................xiii
LIST OF TABLES......................................................................................................xix
LIST OF FIGURES...................................................................................................xxiii
LIST OF ABBREVIATIONS.......................................................................................xxvii

1 INTRODUCTION...................................................................................................1
   1.1 Problem of statement.....................................................................................2
   1.2 Objectives.....................................................................................................4
   1.3 Hypothesis and research questions.............................................................4
   1.4 Methodology and organization of the thesis.............................................4

2 THEORETICAL FRAMEWORK AND LITERATURE REVIEW
   OF SUGARCANE AND SUGAR INDUSTRY.......................................................7
   2.1 Definition of competitiveness.................................................................7
   2.2 Indicators of competitiveness...................................................................8
      2.2.1 Technology.........................................................................................9
      2.2.2 Input cost.........................................................................................10
      2.2.3 Production economies.....................................................................10
      2.2.4 Production quality and enterprise differentiation.............................11
      2.2.5 Advertising and promotion..............................................................11
      2.2.6 External factors..............................................................................11
   2.3 Theory of competitiveness..........................................................................12
   2.4 Concept of typical farm approach............................................................14
   2.5 Reviews of literature on competitiveness of sugarcane and
      sugar industry in Thailand........................................................................15
2.5.1 The impact of international policy on the sugar industry ......................................................... 16
2.5.2 Cross-country comparisons of Thailand sugar industry and other countries ............................. 17
2.5.3 Comparative costs and competitiveness of Thailand sugarcane and sugar industry ............... 18

3 STUDY AREA, DATA COLLECTION AND RESEARCH METHODOLOGY ........................................ 21
3.1 Data source ................................................................................................................................. 21
3.2 Research area ............................................................................................................................ 21
3.3 Sampling procedure and data collection ..................................................................................... 23
3.4 Data analysis ............................................................................................................................... 28
3.5 Farm costs calculation ............................................................................................................... 29

4 SUGAR MARKET AND POLICY IN THAILAND .......................................................... 37
4.1 Sugar market ............................................................................................................................. 37
4.1.1 Sugar production .................................................................................................................. 37
4.1.2 Sugar consumption .............................................................................................................. 40
4.1.3 Sugar exports ....................................................................................................................... 47
4.2 Sugar policy .............................................................................................................................. 53
4.2.1 Export regulations and quota system .................................................................................. 53
4.2.2 Import regulations ............................................................................................................... 55
4.2.3 Quota marketing system for sugarcane .............................................................................. 55
4.2.4 Sugar cane price determination ......................................................................................... 58
4.2.5 Market channel for sugar ................................................................................................. 64

5 SUGAR CANE PRODUCTION AND SUGAR INDUSTRY IN THAILAND .................................. 67
5.1 Structure of sugarcane production ............................................................................................ 67
5.2 Process of sugarcane growing .................................................................................................. 72
5.3 Structure of the sugar industry ................................................................................................ 77
5.4 Process of sugar production ..................................................................................................... 80
Table of Contents

6 PROFITABILITY OF SUGARCANE PRODUCTION IN THAILAND

6.1 Overview on research area
6.2 Patterns and costs of input use in sugarcane production
6.3 Revenue of sugarcane production
6.4 Economic profit of sugarcane production
6.5 Break-even points of sugarcane production
6.5.1 Definition of break-even yield and break-even price
6.5.2 Break-even yield and break-even price of sugarcane production
6.6 Comparison of gross margins of sugarcane production
6.7 Comparison of sugarcane production and competing crops
6.7.1 Production of competing crops
6.7.2 Profitability of sugarcane and its competing crops
6.8 Conclusions for the competitiveness of sugarcane production in Thailand

7 COMPETITIVENESS OF SUGAR FACTORIES IN THAILAND

7.1 Characteristics of the investigated sugar factories
7.2 Analysis of sugarcane supply
7.3 Sugar sales
7.4 Sugarcane transport from field to factory
7.5 Analysis of sugar production of the sugar industry
7.6 Analysis of the extraction rate of sugar
7.7 Analysis of sugar production costs
7.8 Profitability analysis of sugar production
7.9 Competitiveness of the investigated sugar factories
7.10 Environmental regulation of the sugar industry
7.10.1 Waste water treatment
7.10.2 Air emissions control
7.10.3 Residual control
7.11 Problems and obstructions of sugar industry
<table>
<thead>
<tr>
<th>Section</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.12  Suggestion of ways to solve problems</td>
<td>135</td>
</tr>
<tr>
<td>and future strategies of the sugar</td>
<td></td>
</tr>
<tr>
<td>industry</td>
<td></td>
</tr>
<tr>
<td>7.13  Conclusion</td>
<td>136</td>
</tr>
<tr>
<td>8     SUMMARY AND CONCLUSIONS</td>
<td>137</td>
</tr>
<tr>
<td>9     GERMAN SUMMARY (Deutsche Zusammenfassung)</td>
<td>143</td>
</tr>
<tr>
<td>APPENDIX</td>
<td>149</td>
</tr>
<tr>
<td>REFERENCE</td>
<td>171</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table 2.1 Competitiveness of sugar production is influenced by the following location factors...........................................13
Table 3.1 Farm samples, classified by irrigation and region.........................24
Table 3.2 Sampling procedure from number of sugarcane farmers and their shares in each region........................................24
Table 3.3 Structure of the sugar industry in Thailand..................................26
Table 3.4 Sugar factories interviewed..........................................................28
Table 3.5 Calculation of sugarcane production cost......................................29
Table 4.1 Development of sugar production quantity and share of raw sugar, white sugar, and refined sugar from production year 1994/95 to 2004/05..................................................38
Table 4.2 Development of sugar production and consumption in Thailand..........................................................42
Table 4.3 Domestic sugar consumption and income from sugar sales in Thailand, classified by plantation white sugar and refined sugar..................................................43
Table 4.4 Development of household and industry consumption of sugar in Thailand..........................................................45
Table 4.5 Development of white sugar and refined sugar consumption in Thailand..........................................................46
Table 4.6 Development of domestic sugar sales to indirect consumption classified by type of industrial sector.................47
Table 4.7 Thailand’s sugar exports to the world market, classified by raw sugar, white sugar and refined sugar in 2004..........48
Table 4.8 Top ten's Thailand sugar export to the world market between 1992 and 2004..................................................50
Table 4.9 Quantity of sugar export classified by raw sugar and white sugar between production year 1995/96 and 2005/06......52
Table 4.10 Sugar imports under the agreement of the World Trade Organization (WTO) between 1995 and 2003.............53
Table 4.11 Development of the Sugar quotas in Thailand (Tons).............54
Table 4.12 Actual sugar imported and tariff for government import policy on sugar follows WTO agreement during 1995 to 2004.....55
Table 4.13 Development of sugarcane prices from 1991/92 to 2000/01......63
Table 5.1 Development of sugar cane production in Thailand..............68
Table 5.2 Sugarcane area in Thailand by region in production year 2004/2005.................................................................71
Table 5.3 Structure of sugarcane farms in Thailand..........................72
Table 5.4 Calendar of sugarcane planting and activities crossing the summer season............................................................73
Table 5.5 Calendar of sugarcane planting and activities at the beginning of rainy season.........................................................74
Table 5.6 Structure of the sugar industry in Thailand classified by province...............................................................78
Table 6.1 Development of sugarcane production and sugarcane yields in the main sugarcane producing provinces.................88
Table 6.2 Details of calculation of total production costs of sugarcane farms.................................................................90
Table 6.3 Summary of the average total cost of sugarcane production classified by regions....................................................95
Table 6.4 Average sugar cane yield and price received of farm classified by regions in Thailand in the production year 2004/2005.................................................................96
Table 6.5 Comparison of the total revenue of sugarcane production classified by regions.......................................................99
Table 6.6 Profit of sugarcane farms classified by ratoon and regions.......101
Table 6.7 Break-even yield and break-even price of sugarcane production classified by ratoons and regions..............................104
Table 6.8 Revenues, variable costs and gross margins of sugarcane production classified by ratoon and region in the production year 2003/2004.........................................................107
Table 6.9  Profitability of sugarcane production and its competing crops in the production year 2003/04
Table 7.1  Characteristics of the analyzed sugar factories
Table 7.2  Structure of sugarcane suppliers
Table 7.3  Share of total sugarcane received (%)
Table 7.4  Share of total sales in monetary value (%)
Table 7.5  Average distance of sugarcane transport from field to the sugar factory in the year 2003/04
Table 7.6  Productivity indicators in Thailand's sugar industry
Table 7.7  Variable costs of sugar production in Thailand
Table 7.8  Total cost of sugar production in Thailand in the year 2003
Table 7.9  Profit of sugar production in Thailand
Table 7.10 Ranking of the investigated sugar factories according to their competitiveness
Table 7.11 Analysis of the problems and obstruction of sugar factories
Table 7.12 Effect of problems the factories expect to encounter in the future
LIST OF FIGURES

Figure 1.1  World price of raw sugar, 1950-1999 deflated by manufactures unit value index (1990=100)…………………………………….2
Figure 1.2  Sugarcane production trend in different region from production year 1982/83 to 2004/05………………………………………3
Figure 2.1  Farm area………………………………………………………14
Figure 2.2  The selection of farm size……………………………………….15
Figure 3.1  Map of Thailand and study area……………………………………22
Figure 3.2  How total farm gross margin relates to farm business profit………33
Figure 3.3  Break-even point analysis…………………………………………35
Figure 4.1  Development of sugar production in Thailand from production year 1994/95 to 2004/05 .............................................39
Figure 4.2  Comparisons of sugar production in production year 1994/95 and 2004/05…………………………………………………………40
Figure 4.3  Development of sugar consumption in different parts of the world between 1994/95 and 2003/04……………………………………41
Figure 4.4  Development of sugar consumption in Thailand………………….42
Figure 4.5  Market channel of sugarcane in Thailand…………………………56
Figure 4.6  Sugarcane market structure…………………………………………57
Figure 4.7  Management of Revenue Sharing System…………………………59
Figure 4.8  Sugarcane price determinations under the revenue sharing system………………………………………………………………………61
Figure 4.9  Development of sugarcane prices……………………………………62
Figure 4.10  Domestic Sugar Market Structure……………………………………64
Figure 5.1  Development of sugarcane production and planted area in Thailand………………………………………………………………………..69
Figure 5.2  Development of the sugarcane yield from 1982/83 to 2003/04 in Thailand……………………………………………………………………69
Figure 5.3  Geographic information system (GIS) map of the sugarcane area in production year 2003……………………………………………70
Figure 5.4  Development of the share of sugarcane planted area by
Figure 5.5  The Simplified Process Flow Diagram for Cane Sugar Production
Figure 5.6  The Simplified Process Flow Diagram for Refined Sugar Production
Figure 6.1  Farm size of typical sugarcane farms analyzed in different regions
Figure 6.2  Total costs of sugarcane production for the first ratoon classified by cash costs, depreciation costs and opportunity costs in different regions in production year 2003/2004
Figure 6.3  Total costs of sugarcane production for the second ratoon classified by cash costs, depreciation costs and opportunity costs in different regions in production year 2003/2004
Figure 6.4  Total costs of sugarcane production for the third ratoon classified by cash costs, depreciation costs and opportunity costs in different regions in production year 2003/2004
Figure 6.5  Total revenue of sugarcane production for the first ratoon classified by regions in production year 2003/2004
Figure 6.6  Total revenue of sugarcane production for the second ratoon classified by regions in production year 2003/2004 in Baht per rai
Figure 6.7  Total revenue of sugarcane production for the third ratoon classified by regions in production year 2003/2004
Figure 6.8  Comparison of total variable costs and total fixed costs of sugarcane and competing crops
Figure 6.9  Comparison of total revenue, gross margin farm income and profit of sugarcane production and competing crops
Figure 7.1  Sugar extraction rates of the investigated sugar factories (kg per ton of sugarcane)
Figure 7.2  Extraction rate of sugar (kg of sugar per ton of sugarcane) in production year 2002/03
Figure 7.3  Extraction rate of sugar (kg of sugar per ton of sugarcane) in production year 2002/03 ..........................125
**LIST OF ABBREVIATIONS**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>Percent/percentage</td>
</tr>
<tr>
<td>BHT</td>
<td>Thai Baht (Thai Currency)</td>
</tr>
<tr>
<td>C.C.S.</td>
<td>Commercial Cane Sugar</td>
</tr>
<tr>
<td>cm</td>
<td>Centimetre</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and Agriculture Organization of United Nation</td>
</tr>
<tr>
<td>FIPI</td>
<td>Foundation for Thailand Productivity Institute</td>
</tr>
<tr>
<td>GATT</td>
<td>The General Agreement on Tariffs and Trade</td>
</tr>
<tr>
<td>Ha</td>
<td>Hectare</td>
</tr>
<tr>
<td>HFCS</td>
<td>High Fructose Corn Syrup</td>
</tr>
<tr>
<td>IFCN</td>
<td>International Farm Comparison Network</td>
</tr>
<tr>
<td>IO</td>
<td>Industrial Organization</td>
</tr>
<tr>
<td>m</td>
<td>Metre</td>
</tr>
<tr>
<td>OAE</td>
<td>Office of Agricultural Economics</td>
</tr>
<tr>
<td>OCSB</td>
<td>The Office of the Cane and Sugar Board</td>
</tr>
<tr>
<td>TCSC</td>
<td>Thailand Cane and Sugar Corporation</td>
</tr>
<tr>
<td>TDRI</td>
<td>Thailand Development Research Institution</td>
</tr>
<tr>
<td>Tons</td>
<td>Metric Tons</td>
</tr>
<tr>
<td>USS</td>
<td>US Dollar</td>
</tr>
<tr>
<td>WTO</td>
<td>World Trade Organization</td>
</tr>
</tbody>
</table>

1 Rai = 0.16 ha  
1 Baht = 0.02 Euro
1 INTRODUCTION

The sugar industry in Thailand has been growing rapidly, both in sugar cane production and in sugar mill expansion. Demand from domestic and international markets has been rising and has contributed to the economic growth of the nation. Sugar cane growing and processing into raw sugar is one of the largest industries in the country. Thailand is one of the largest sugar exporters in the world. The total export of white and raw sugar was 3.22 million tons in 2000. The Office of the Cane and Sugar Board (OCSB) under the Ministry of Industry has reported the total value of sugar exports for the crop-year 1998-1999 at 21.21 billion Baht (Chetthamrongchai, et al. 2001).

Thailand sugar industry has historically been insulated from volatility on the world sugar market through the use of an import quota. As a result, the domestic price of sugar in Thailand has been supported at levels above the world price (Manarangsan and Kaewthep 1987).

Since the Uruguay Round of the General Agreement on Tariffs and Trade (GATT), agricultural trade liberalization has become a very important issue. As a major agricultural exporting country, Thailand stands to gain from agricultural liberalization, since most of the Thai agricultural products can compete in the world market with little or no subsidy. Even in the case of sugar where the two-price policy could be considered a certain kind of subsidy scheme, the rate of subsidy as such is relatively low, compared to the agricultural subsidies received by farmers in the European Union (EU), the USA and Japan. Therefore, if all export subsidies and trade barrier measures are removed, the Thai sugar industry, one of the three major exporters in the free-trade market, will certainly benefit from such liberalization. Thailand’s competitiveness in agriculture has thus far been based on cheap labor and a relative abundant land resource, acquired through deforestation. These two factors are no longer Thailand’s strength. Even though the existing resources would keep Thailand as one of the major food exporters for a long time, further large-scale expansion of arable land is no longer feasible. Moreover, the unskilled wage rate that decreased slightly in the wake of economics crisis is likely to return to its normal trend in the medium and long term. Another factor that would affect Thailand’s competitiveness is the world sugar price. Like most agricultural products, real sugar price shows declining tendency in the long run (Figure 1.1). Among other things, the deterioration of the real prices of agricultural prices results from productivity and efficiency improvements like place in exporting and importing countries, and in the case of sugar, both in the cane fields and sugar mills. Therefore, if Thai cane growers were to compete in the world market while facing higher labor and other input price, the only way out would be to increase their farm productivity (Netayarak, et.al 1994).
Given these potential changes, how are the various regions and sectors of the Thailand sugar industry positioned to compete in the world market? Thus, this research is realized on an indicator in order to determine the competitive position of the sugar industry in Thailand. The results of this study will provide basic information for policy planners to provide several implications for the sugar industry as it prepares to compete in this new policy environment.

1.1 Problem of statement

Sugar cane production is one of the major economic sectors in Thailand. There are several activities involved in the production process such as sugarcane growing, sugar milling, credit banking, exportation, etc. The sugar production activities provide significant full time and temporary employment in sugar factories, sugar transformation, transportation and exports.

The Thai sugar production shows a pattern of progressive growth in sugarcane production from 1982 to 1997 (Figure 1.2). In 2002/03, the total sugarcane production in the country was about 74.1 million tons.

Thailand ranks third among sugar cane exporters in the world market, next to Brazil and Australia in 1997, and this activity contributed to its national income by up to 20,000 million Baht (Srijantr 1998).
However, sugarcane production dropped down in some years because the sudden fall in price has revealed much about the productivity and international competitiveness of Thailand’s sugar investments. Many mills struggle financially until today. They are unable to meet their interest repayments, some require additional borrowings to remain financially solvent and most are forced to lower prices for sugarcane. Low prices for sugarcane raise doubts about whether adequate supplies will be achieved in the future to maintain mill production.

There are several issues for investigation on how to improve sugar cane productivity in terms of economic output, qualitative and quantitative production scales. Still, the Government of Thailand remains concerned about the international competitiveness of the sugar industry.

Figure 1.2  Sugarcane production trend in different region from production year<sup>2</sup> 1982/83 to 2004/05

![Sugarcane production trend in different region from production year 1982/83 to 2004/05](image)

**Source:** OCSB (1982).

---

<sup>2</sup> Production year is the time period that sugarcane farmers expect to harvest and bring all sugarcane harvested to sugar factory: 1 October to 31 May of the following year or so called “crushing year” (OCSB 1991).
Chapter 1

1.2 Objectives

The overall objectives of this research are to analyse the competitiveness of the sugar industry in Thailand. This thesis combines an in-depth sugarcane farm and sugar industry interview with a qualitative and quantitative data analysis. Based on the above considerations, this thesis has key objectives as follows:

1. To study the structure of sugarcane and sugar production in Thailand
2. To analyse costs and returns of sugarcane and sugar production in Thailand.
3. To examine the competitiveness of the sugar industry and identify indicators of competitiveness.
4. To describe strategies of sugarcane growers and sugar factories for improving competitiveness.

1.3 Hypothesis and research questions

The principal hypothesis of this thesis is that higher competitiveness of domestic sugarcane growers and sugar industry can improve them to compete with other sugar exporting countries under liberalization of world trade. To evaluate the competitiveness of sugarcane farms and sugar industry under the decreasing world demand for sugar import, this thesis focuses on the following research questions:

1. What is the current situation of the sugar industry and sugar market in Thailand?
2. What are the important obstructers or limiting factors toward the competitiveness of the sugarcane growers and sugar industry?
3. How can the sugarcane growers and sugar industry be improved at low production costs? What are the strategies for and improving of the competitiveness of the Thai sugar industry?
4. What are the government policy implications to help sugarcane growers and the sugar industry in Thailand?

1.4 Methodology and organization of the thesis

This study focuses on comparing the costs and returns between sugarcane and its competing crops in Thailand. Field surveys and interviews have been carried out with people involved in sugarcane production activities. Additional secondary data were reviewed to support the research.

This thesis is structured in eight chapters. The first chapter gives an introduction in the work, including problem statement, objective, hypothesis and organization of the thesis. After the first chapter, a thorough literature review presents the concept of typical farm approach, the theory of competitiveness,
Introduction

and indicators of competitiveness. The third chapter presents study area, data collection and research methodology. In chapter four, the Thai sugar market and policy is presented. Chapter five presents the structure, and production process of sugar cane growing and milling in Thailand. In chapter six and seven the results of the farm and factory interviews are presented. They concentrate on profitability, competitiveness and future strategies of cane growers and sugar mills. The last chapter of the thesis draws conclusions and gives policy recommendations to improve the competitiveness of the Thai sugar industry.
2 THEORETICAL FRAMEWORK AND LITERATURE REVIEW OF SUGARCANE AND SUGAR INDUSTRY

The literature review on sugar is broad and extensive. However, the literature review on the competitiveness of sugar industry, especially in Thailand is rare. The existent research on sugar in Thailand concentrates on different issues such as the pros and cons of international policy on sugar industry, production cost analysis and benefit of the revenue-sharing system.

The literature is structured in four sections. In order to give a better understanding on the competitiveness analysis, first the concept of competitiveness is defined. Second, the indicator of competitiveness is explained due to these indicators are all sources that influence competitiveness. Third, the theory of competitiveness - how it is measured and applied- is examined from different perspectives. Fourth, concept of typical farm approach as an instrument for selecting farms for farm surveys. The chapter ends with the review literature on sugarcane and sugar industry in Thailand.

2.1 Definition of competitiveness

Competitiveness has been defined from a number of different perspectives. Some have defined competitiveness as the ability to sustain an acceptable growth rate and real standard of living (Landau 1992). This definition is linked to a nation's employment and, consequently, the standard of living of its citizens. The level of national employment, growth of employment, and the standard of living in an economy depend on the competitiveness of firms within the country. Analyzing a nation's competitiveness requires that the underlying factors that influence the competitiveness of individual firms and industries are examined (Porter 1990).

At the level of individual firms, competitiveness is the ability of a firm to survive and prosper, given the competition of other firms for the same profits. The competitiveness of a firm is the result of a competitive advantage relative to other firms. Porter defines competitive advantage as the ability of a company to make products that provide more value to the customer than rival products, leading to higher sales and higher profits for that company. However, the ability to create higher value and to extract more profit at one point in time is not sufficient for a company to have a competitive advantage. Rivals will be quick to imitate either the products or the production processes of a firm, and compete for its profits. Competitive advantage is only achieved if a company manages to sustain its edge over its rivals over time (Porter 1996).
Agribusinesses become more competitive through cost leadership and/or product differentiation (Porter 1980). More specifically, technology attributes of purchased inputs, product differentiation, production economies, and external factors are the primary sources of competitiveness (Harrison 1997). Each of these factors affects a firm's costs and the degree to which it can differentiate its products. These factors also affect profits and market share (Kennedy 1998).

Some author defined competitiveness as an indicator of the ability to supply goods and services at the location and in the form and at the time sought after by buyers, at prices that are as good as or better than those of potential suppliers, while earning at least the opportunity cost of returns on resources employed (Frohberg and Hartmann 1997).

The concept of competitiveness traditionally refers to the ability of a firm or a group of firms (as part of an inter-related system) to gain market share, in the international or domestic market. This is typically advanced by creating cost efficiencies throughout the inter-related chain of firms resulting in increasing returns to capital and labor (ANZIBA 2004).

Therefore, the definition of competitiveness refers a competitive industry is one that possesses the sustainability to profitably gain and maintain market share in domestic and/or foreign markets (Martin 1991). The global competitiveness of a company is a concept that must express performance of the company in the long term, which is essentially its growth. In relative terms, it is the capacity of the company to achieve good results higher than the average. Economists often privilege cost and price aspects of the competitiveness. The unit cost is one of the competitiveness indicators most used to compare the cost-competitiveness of firms or an area of one or several countries (FMA 2006). For the purpose of this study, profitability is considered as a leading indicator of competitiveness will be considered in subsequent research.

### 2.2 Indicators of competitiveness

Technology, input costs, production economies, product quality and enterprise differentiation, advertising and promotion, and other external factors are all sources that influence competitiveness. These sources can be grouped into two categories: those that affect the firm's relative cost of production and those that affect the quality, or perceived quality, of its product and/or business enterprise. As the firm gains advantage in the various sources of competitiveness, relative market share and profits increase. In situations where a firm is able to decrease production costs or improve its products relative to other firms in the industry, market share will increase.

---

3 This section comes from the work of Kennedy et.al, 1998.
The ability of existing firms to profitability gains and maintains market share indicates that they possess a competitive advantage. Yet knowledge of a firm’s profitability and/or market share does not provide information regarding any single source of competitiveness. For example, an increase in the profitability of a state’s sugar industry may indicate an increase in competitiveness, but it does not indicate whether this is a result of decreased cost, increased quality, or currency change like a devaluation of the U.S. dollar. Similarly, a firm’s relative advantage in any particular source of competitiveness does not guarantee profitability or a sustained share of the market. Furthermore, cost-reducing technologies that adversely affect product quality may not be necessarily to increase competitiveness. This implies that the measures and indicators to be used must be chosen based on the individual circumstances of the firm.

There may not be any one “best” measure of competitiveness. Market share and profitability provide useful insight into the overall competitiveness of a firm. At the same time, the individual sources of competitiveness provide information with respect to the firm’s relative strengths and weaknesses. When utilized separately, these tools provide a useful indication of the competitive position of the business. However, when used together these measures provide information regarding the firm's current position in the market, indicate the relative strengths to be maintained and exploited, and identify the relative weaknesses that are a prime area for improvement. The above mentioned framework will be used to examine the factors that affect competitiveness levels within Thailand sugar industry as well as specific measures of competitiveness.

Indicators of competitiveness divided into technology, input costs, production economies, product quality and enterprise differentiation, advertising and promotion, and external factors.

### 2.2.1 Technology

Cost advantage can be achieved through proprietary technologies that affect the productivity of labour and capital. The development and adoption of these technologies affect the firm in several ways. The impact of employing new methods depends, to a large extent, on firm behaviour and industry structure. For example, a productivity-enhancing technology enables the firm to lower production costs. Other technologies allow the firm to increase its quality of output given an initial set of inputs.

Suppose a technology is developed, such as a new fertilizer application technique or a hybrid plant variety, which increases yields in the sugar industry. Upon adoption of this new method the producer could apply the same amount of inputs as before, resulting in increased production levels. On the other hand, an appropriate reduction in the amount of inputs applied will result in production levels equal to those achieved with the old technology. In these case, per unit
costs of production will decrease. This method is classified as a productivity-enhancing technology.

Consider another example. Suppose that a method is developed that allows sugar processors to enhance the quality attributes of their final product. Application of this new technique permits the firm to differentiate its product by creating superior quality. Given this increase in product quality, one would expect that consumers will be willing to pay more for this product. However, unlike the productivity-enhancing technology, the processor may also incur increased costs associated with this higher quality level.

These examples illustrate the primary differences between productivity-enhancing and quality-enhancing technologies. A technology is productivity-enhancing if its adoption enables the firm to decrease its costs per unit of output. On the other hand, a technology is quality-enhancing if its adoption enables the firm to increase quality per unit of input. Despite the inclination to categorize technology as either productivity-enhancing or quality-enhancing, there are many technologies that cannot be pigeonholed into just one classification. The existence of technologies that are both productivity- and quality-enhancing, combined with the effects of firm behavior; imply that cost and quality factors both affect firm competitiveness.

2.2.2 Input cost

Costs are also influenced by the price, quality, and dependability of purchased inputs. This is one of the most direct and obvious sources of competitiveness. Even so, it is difficult for a firm to attain an advantage in this area. To illustrate this point, consider two sugar mills. Suppose sugarcane composes the same share of production inputs for two companies and that the cost of sugarcane declines. This decrease in the cost of inputs affects both firms in the same way. However, it does not change either firm’s cost of production relative to the other. To gain a competitive edge, a firm must lower input costs relative to those incurred by rival firms.

2.2.3 Production economies

Production efficiency can be improved through scale economies and broadening the scope of production. A firm’s efficiency increases when its output is adjusted in a way that decreases average costs of production. For example, one of the arguments for the efficiency of the United States meat packing industry is its evolution from a large number of medium sized packers to an industry where a few large firms control most of the market. The increased size of these firms reduces total costs through a greater division of labor, resulting in increased competitiveness.
Economies can also be achieved by broadening the scope of products that a firm produces. The firm's scope can be adjusted to produce a wide variety of products that are close substitutes in the production process. An example of this would be the diversification of a producer of Cola products to include other soft drinks. Expansion of its product line in this manner would allow the firm to utilize excess capacity. Thus, economies of scope permit the firm to spread the cost of its fixed assets over additional lines.

2.2.4 Production quality and enterprise differentiation

Product differentiation refers to the degree in which products of competing sellers substitute for one another in consumption. Many agribusiness firms differentiate their products from those of their competitors in order to increase market share and develop consumer loyalty. A primary way in which firm differentiates their products is by providing superior product quality. Research and development, quality control, and the use of higher quality inputs are among the sources that affect product quality. Another factor that affects a firm's competitiveness is enterprise differentiation, which refers to the firm's ability to distinguish itself from rivals. By providing superior services, firms can enhance the reputation of their company and product lines.

2.2.5 Advertising and promotion

Brand advertising and other promotional strategies influence the consumer's perception of a product, thus increasing their demand. A successful advertising strategy establishes a barrier to market entry by creating brand loyalty. This loyalty is based on the customer's perception that the preferred product conveys greater value relative to close substitutes. Brand loyalty allows a firm to pursue one of two strategies. The firm can sell the same amount of its product at prices higher than competitors, or it can sell more of its product at prices equal to competitors. In either case, demand for the firm's product increases, as does its relative competitiveness in the market.

2.2.6 External factors

There are a number of external factors that influence the competitiveness of agribusiness firms and industries. A variety of government policies can affect an industry's competitiveness in both domestic and international markets. For example, government policies that subsidize the production of raw agricultural commodities directly affect the prices that food processors pay for inputs. Lower priced inputs lead to lower costs for the downstream firms and an increase in their competitiveness relative to foreign rivals.
Government policies also affect an agribusiness firm's ability to obtain world market share. For example, government export subsidies lower the world price at which domestic industries are willing to sell various quantities of their product. This acts to expand the subsidized industry's world market share. Macro-economic variables, such as exchange rates, consumer incomes, and population growth also influence the competitiveness of the firm. For example, a devaluation of the U.S. dollar has the effect of lowering the price of U.S. goods in foreign markets. Although individual firms have little influence on the exchange rate, they benefit from increased profits and market share. Thus, government policies and other factors beyond the firm's control impact competitiveness.

2.3 Theory of competitiveness

The theory of competitiveness has been analyzed using three approaches (Thorne 2004): traditional trade theory, industrial organization theory and strategic management theory.

Traditional economic trade theory provides useful insights into the development of the concept of competitiveness. However, some authors identified the focus of traditional trade-based theories of competitiveness as being inherently structured on supply side economics. Relative price differentials have remained the primary indicators of competitiveness definitions based on trade theory. Therefore, it must be concluded that these theories do not account very well for demand side economics. There is an inherent failure amongst these theories to address qualitative differences in products, marketing and service abilities of firms and the strategies by which industries attain competitiveness (McCalla 1994).

The main focus of Industrial Organization (IO) theory is the identification of variables that influence economic performance (Van Duren and Martin et al. 1991). The difference between the economics trade theory and IO theory is based on the emphasis on supply side economics and demand side economics respectively. The strategic Management theory viewed a theory of competitiveness which brings together the concepts of both trade theory and IO. Competitiveness has many dimensions in that it refers to: 1) countries or regions – spatial dimension, 2) sectors or industries or firms – activity dimension, 3) the present or future – dynamic or innovation dimension. These dimensions matter when we measure competitiveness (Morgenroth 2005).

The concept of competitiveness includes various aspects on a spatial level (firm level, branches of trade, national) as well as on a timely level (short term, long term). Put simply, the international competitiveness of branches like the sugar industry expresses the ability of domestic firms to compete with foreign firms (NIELSEN et al 1995). Competitiveness is determined by various location
factors (Table 2.1), conclusions on the competitiveness of sugar production under current and liberalized market conditions can only be drawn from an analysis of the current natural, economic and political production conditions and the expected development of the different location factors (Zimmermann and Zeddies 2001).

Therefore, this research analyzes production costs and profitability of sugar production in the different locations because costs and profitability are important to compare competitiveness as the above literature reviews. The data base consists of own surveys, information from local research, government, literature, and other statistics.

**Table 2.1 Competitiveness of sugar production is influenced by the following location factors**

<table>
<thead>
<tr>
<th>Natural location factors</th>
<th>Field (Beet/Cane Production)</th>
<th>Factory (Processing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- temperature</td>
<td>- sugar yields</td>
<td>- crushing campaign</td>
</tr>
<tr>
<td></td>
<td>- need for irrigation/draining</td>
<td></td>
</tr>
<tr>
<td>- rainfall</td>
<td></td>
<td>- possibility of machinery use</td>
</tr>
<tr>
<td>- topography</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Economic location factors</th>
<th>Field (Beet/Cane Production)</th>
<th>Factory (Processing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- opportunity costs of labor, land and capital</td>
<td>- wages, land prices and interest rates</td>
<td>- wages, land prices and interest rates</td>
</tr>
<tr>
<td>- productivity</td>
<td>- unit costs</td>
<td>- unit costs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Political location factors</th>
<th>Field (Beet/Cane Production)</th>
<th>Factory (Processing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- subsidies: - product prices, factor prices</td>
<td>- beet/cane prices, prices for water, energy etc.</td>
<td>- sugar prices, prices for water, energy etc.</td>
</tr>
<tr>
<td>- taxes</td>
<td>- taxes on income, property and energy etc.</td>
<td>- taxes on income, property and energy etc.</td>
</tr>
<tr>
<td>- regulations: - social standards</td>
<td>- non-wage labor costs, costs, caused by regulations for air emissions, effluents, waste</td>
<td></td>
</tr>
<tr>
<td>- environmental standards</td>
<td>- costs, caused by regulations for fertilizer and pesticide use</td>
<td></td>
</tr>
</tbody>
</table>

**Source:** Zimmermann and Zeddies (2001).
2.4 Concept of typical farm approach\textsuperscript{4}

Concerning the farm and factory survey in this study, the way of sampling is based on the concept of ‘Typical Farm Approach’. Data collection within the International Farm Comparison Network (IFCN)\textsuperscript{5} takes place on whole farm level. For enterprise calculations like \textit{production cost analysis}, whole farm data are reallocated to the enterprise according to the extent of their use in each of the enterprises considered. Farm level data for typical farms are derived from so called “panels”. Depending on the information required, a so called “pre-panel” or a “full panel” is established for each typical farm model (IFCN 2004).

The following is an example of typical farm models for a sugarcane farm. A typical sugarcane farm represents a significant number of sugarcane farms in a region in terms of size, irrigation system, farming systems, labour organization and production technology used. For selection of typical sugarcane farms, we first identify the region(s) in a country where sugarcane production is most important in terms of volume of production and/or density of sugarcane (Figure 2.1).

\textbf{Figure 2.1 Farm area}

![Diagram of farm area with region A-H]

\textit{Sugarcane regions are: A,D,G}

\textbf{Source:} IFCN (2004) and own modification.

\textbf{Selection of moderate and large farms:} In each region and for each relevant farm type we intend to set up one moderate (average) sized farm and one large farm to represent (a) a significant number of farms, (b) a large amount of production in the area and (c) to capture economies of scale. Size is the most

\textsuperscript{4} This section applies from IFCN, 2004.

\textsuperscript{5} IFCN is a worldwide association of agricultural scientists, advisors and farmers.
important issue to characterize “typical”. For sugarcane farms, this study measure size in average farm size, which is expressed in rai $^6$ (Figure 2.2).

**Figure 2.2  The selection of farm size**

![Diagram showing the selection of farm size](image)

Source: IFCN (2004) and own modification.

### 2.5 Reviews of literature on competitiveness of sugarcane and sugar industry in Thailand

In the review, literature on Thai sugar industry is divided into three sections. The first section comprises the review of the impact of international policy on the sugar industry. The second section contains literature on the cross-country comparison of Thai sugar industry and other countries. The third section covers literature on the comparative costs and competitiveness of Thai sugarcane production.

---

$^6$ Rai is a traditional unit of land area in Thailand. The rai is now considered to equal exactly 1600 square meters, which is 0.16 hectare or approximately 0.3954 acre. The rai is divided into 4 ngan. The
2.5.1 The impact of international policy on the sugar industry

The impacts of agricultural liberalization of the World Trade Organization (WTO) on the Thai sugar industry were studied in many points (Petchworakul 2001). The policy commitments a) reduction in sugar tariff, b) reduction in sugar producer price support of Thailand, and c) reduction in sugar production subsidy of WTO members were studied. The methodology employed was the computable general equilibrium approach whereby inter-linkage among industries is analyzed and the impacts of agricultural liberalization of the inter-relationship among economic agents are integrated into the model. The model used in the study based on CAMGEM (Chulalongkorn and Monash General Equilibrium Model), is a multi-sectoral model analysis of Thai economy.

The results indicated that the WTO agricultural liberalization benefit the sugar industry, expand the related industries and enhance the growth of the Thai economy. Consumers will gain benefit from the reduction of tariff and the government will not have to pay the subsidy to the sugar industry anymore. The sugar producer will lose benefit from reducing in sugar price, but can be offset by export expansion. In case of WTO’s other member countries liberalization, the producer will gain more from rising in quantity of export, but the consumer will lose from higher domestic price. Finally, the WTO liberalization will lead Thai sugar industry to a higher competition. So, the improvement in production efficiency will be the necessary way for this industry to compete in the world market.

Another research focuses on the impact of lifting important trade barriers, i.e. market access, lower import quota, lower import tariff, and lower producer and export subsidies, upon the world production and trade on sugar industry (Ngarmyarn and Techawed 1996). Econometric analysis has been undertaken to estimate the coefficients of the world sugar industry adjustment when all The General Agreement of Tariffs and Trade (GATT) members have to reduce their trade barriers according to the GATT agreement. EU, Australia, Cuba, Brazil and Thailand are modelled as major world net exporters while the USA, Japan, South Korea and China are placed as important world net importers which can influence the structure of world sugar trade.

Results of the study suggest that world white and raw sugar prices tend to increase a little bit under the bound GATT agreement because many countries have submitted high based for calculation tariff and subsidy reduction. The expected consequence is the minimal reduction of sugar production within the major importing countries which also produce sugar domestically and within some exporting countries that currently produce sugar at high cost such as EU.

---

unit is called the hai in northern Thailand and the lai in Laos. The word means "field," that is, an upland field rather than a rice paddy.
Sugar consumption in some importing countries like Japan and USA will be substituted by HFCS\(^7\). Moreover, per capita consumption of sugar in some developed countries should have a declining trend due to the increase in health consciousness of their population. Therefore, there would be insignificant changes in import and export in the world sugar market for the next ten years. In summary, the future of Thai sugar industry is still bright where the main competitors are Australia, Brazil and Cuba. Thailand has to be alert to maintain the comparative advantage in this industry in the long run. Moreover, Thailand has to look for a new opportunity to produce more value added sugar products. The cooperation from farmers, factories, government and private sectors in research and development is necessary if Thailand still want to maintain a substantial market share in the world sugar market within the next century.

2.5.2 Cross-country comparisons of Thailand sugar industry and other countries

The Foundation of the Thailand Productivity Institute (FTPI) studies cross-country comparisons of production costs of the sugar industry. According to the sugarcane and sugar industry in Thailand, the country’s sugar production costs have always been lower than the world’s average. They also tend to decrease incessantly despite occasional instabilities. However, cost competitiveness of Thailand in general is still considered very good, compared to that of other 63 countries. During 1999/00-2001/02, the average sugar production costs of Thailand stood at US$ 217.8 per ton of sugar. Notably, field costs were US$123.4 per ton of sugar, a decline of 30.1 percent from 1994/95-1998/99. The decline is even lower than that of Brazil, owning the highest level of cost competitiveness in the world. Thailand’s factory costs increased slightly. Nonetheless, Thailand’s competitiveness in the sugar production costs jumped from 21\(^{st}\) in 1994/95-1998/99 to 11\(^{th}\) in 1999/00-2001/02 (FTPI 2004).

Another research on the comparison of sugar industry of Australian and Thailand found that both Thailand and Australia are situated in a net sugar import area which reduces the possibility of world price imports from neighbor countries. This coupled with relatively high freight costs, especially to Australia, enables it to operate with no duties levied on the importation of sugar. Although Thailand administers a high import duty payable on sugar coupled with import

---

\(^7\) High fructose corn syrup (HFCS) is a newer and sweeter form of corn syrup made from corn starch in an enzymatic process developed in the 1970s. By increasing the proportion of fructose, a syrup is produced which is more comparable to an ordinary sugar (sucrose) syrup in its ratio of fructose to glucose and in its sweetness. This makes it useful to manufacturers as a substitute for ordinary sugar (sucrose) in soft drinks and other consumer goods (Wikipedia, 2006).
licensing requirements, government set the domestic price for sugar at a level far lower than import parity. This is possible due to the high returns on export sugar (premium markets and exchange rate benefits) as well as the fact that sugar is produced by small-scale family operations contributing to low operation costs. The sustainability of this practice is questionable. The Australian sugar industry is of the opinion that the only way of increasing competitiveness in the sugar industry is by increasing farm sizes, integration within the value chain and mechanization. Both Australia and Thailand have no or little competition on their local markets, Thailand because of price setting by government and Australia because of a high concentration in the refining sector (DTI 2006).

2.5.3 Comparative costs and competitiveness of Thailand sugarcane and sugar industry

The research related to comparative cost analysis on transportation and other relevant costs of sugar cane production presents that transportation has become a significant factor affecting the production costs of commodities (Chetthamrongchai, Auansakul and Supawan 2001). The production of sugar cane in Thailand is no exception. The cost of transporting sugarcane from the farm gate to the mills is quite high, owing to the multiple transport facilities and time-consuming activities involved in the delivery process. A large portion of this cost comprises truck rental and driver wages. These two elements together represent a high proportion of the overall production cost.

Furthermore, the research that related to the comparative advantage of sugar cane production was studied in the Mae Klong Area, Thailand (Srijantr 1998). The main analyses of this study were on sugarcane production and marketing, and the yield gap and water management. As a result it was found that the region has comparative advantages to other regions regarding the quality of soils, the irrigation network and the infrastructure in terms of transportation and communication. However, the growing awareness of sugarcane in this region is dependent upon gains in productivity and the sugarcane plantation is decreasing in the area while plantation is rising in the North and Northeast regions of country. Crop diversification is driven by competitive crop and new and high value crops are introduced to the area and reduce the importance of sugarcane.

The next research studies the trend of changes and factors causing the changes of the overall Thai cane and sugar industry since the implementation of the revenue-sharing system (Netayarak et al 1994). The study found that problems of rising labor wages, scarcity of cane-cutting labor and inability of cane growers to expand planting areas in the Eastern, the Western and Central regions of Thailand, incorporating with the past government policy in allowing
the location shifting and the capacity expansion of the sugar factories have caused the relocation of many sugar factories from the two disadvantage regions to the Northeastern, the lower-northern and the Central regions of Thailand. Impacts of location shifting and capacity expansion had caused the rapid growth of cane planting area as well as cane and sugar production during the past decade.

The main findings on future pricing policy are as follows. If the producers of sugarcane and sugar wish to maintain the real price, a one million ton increase in sugar production will cause the consumers to pay 68 satang more per kilogram of sugar. If the current nominal price is maintained, an increase in sugar production will insignificantly affect the consumers since their extra burden will be only 1.8 satang per kilogram for an extra production of 1 million ton.

Another research which is involved in competitiveness of sugar industry (Kongchindamunee 2002) has aimed at investigating the competitive strength and stability of Thailand as far as sugar-exporting was concerned. The constant market share models as well as the resulted competitive instability index were analyzed. The proportion of raw sugar exporting volumes of Thailand had gradually decreased, while that of the white sugar had increased on a continual basis. Among the other, Indonesia, other Southeast Asian and East Asian countries have significantly increased their sugar importing volumes from Thailand. The analysis made through the constant market share models over the sugar exporting volumes as a whole in the market revealed that Thailand could annually increase its sugar exporting volumes of 96,069 tons annually. Its sugar exporting volumes could surpass the world growth effect of 25,984 tons annually. When the pure competitiveness effect was considered, Thailand could still surpass those competing countries in the global arena at the volumes of 5,915,051 tons annually.

The Thai sugar industry enters an era of change. This has been pointed out in research of F.O.Licht (2004). The research gave the result that most of the family-controlled sugar business in Thailand will see a hand-over to a new generation of owners and managers. This is likely to be accompanied by a massive restructuring of the industry and a new strategic orientation as far as product portfolios are concerned. At the same time, the government negotiated a new cane payment system between the growers and millers. The developments could have far-reaching implications for the country’s export performance (F.O. Licht 2004).

However, the downturn of the Thai cane and sugar industry and the main problems of Thai sugar industry are also criticized (Naranong 2000). The main problems come from fundamental problems, the agricultural trade liberalization,

---

8 Satang is a unit of currency in Thailand. 100 satangs equal 1 Baht.
the competitiveness, production efficiency, and industry indebtedness. First, domestic subsidy is going to be eliminated due to the agricultural trade liberalization. Second, Thai cane growers were to compete in the world market while facing higher labour and other input prices. Third, efficiency of production is still a major problem of the industry, for example, lack of good sugarcane varieties, sugarcane diseases and meager research and development. Fourth, many Thai sugar mills that was used to obtaining all the credit they wanted and had rather high debt-equity ratios, were flooded by their huge foreign debts, especially after the rapid currency depreciation.
3 STUDY AREA, DATA COLLECTION AND RESEARCH METHODOLOGY

The methodology applied for the farm sampling is based on the concept of typical farm approach. Farm types are determined by sugarcane experts taking into consideration: location of farm, farm size, sugarcane area and share of rainfed and irrigated area. The first category of farms was chosen to represent the size that is close to the statistical average. The other types defined represent larger farms to allow the exploration of potentials for economies of size in the region. Management levels on the typical farms are above average. The sugar factories were categorized by region, industry group and crushing capacity.

This chapter presents of the methodology in detail, are divided into five sections. The data source is explained in section 3.1. The research area of data collection in both sugarcane farm and sugar industry is presented in section 3.2. The sampling procedures are shown in section 3.3. The analysis of data from research field is presented in section 3.4. Finally, the chapter ends up with the calculation of sugarcane production in section 3.5.

3.1 Data source

The data source used in this study consists of both primary and secondary data. The primary data was collected by the use of questionnaires, which were divided into farm and industry questionnaires. Data was collected in the crop year of 2003/04.

With the farm questionnaire, information was collected on farm structure, capacity of machinery and buildings, labour organization, factor costs and returns of sugarcane production, profitability of competing crops, irrigation methods and the future farm strategies.

With the factory questionnaire, data was collected on the company profile, cost of sugarcane transport from sugarcane field to factory gate, factory processing costs, environmental regulations and future factory strategies.

The secondary data has the purpose to analyze the competitiveness of the whole sugar industry in Thailand, which was collected from sources such as the Office of Cane and Sugar Board (OCSB), Office of Agricultural Economics (OAE), Association of the sugar industry, Association of sugarcane growers, sugar factories, sugarcane growers, and sugar traders. The analysis of secondary data used the data from 1982 to 2006.
3.2 Research area

This research work was conducted in Central, Northeastern and Northern Thailand. Figure 3.1 shows the Thailand map and study area. The study area consists of 9 provinces in 3 regions. There are 3 provinces in the Northeast region which are Khon Kaen, Buriram and Udon Thani province. There are 2 provinces in the North region which are Nakhon Sawan and Phitsanulok province and there are 4 provinces in the Central region which are Kanchanaburi, Nakhon Pathom, Bangkok and Prachuap Khiri Khan province. The study area is divided into two parts. First is farm study area. Second is sugar industry.

Figure 3.1  Map of Thailand and study area

Source: Rosenberg (2006) and author’s modification.
The study area of sugar factories is categorized by sugar crushing capacity, sugar industry group, and industry size. The study area is also in the Central, North, and Northeastern region.

As described above, this area was chosen because they have been hypothesized to follow a typical farm approach. The selection of typical sugar cane farms, we first identify the region(s) in a country where sugar cane production is most important in terms of volume of production.

3.3 Sampling procedure and data collection

This study is divided into farm and industry interview. For the farm interview, the sugarcane growers are selected by using the typical farm approach. Sugarcane growers are grouped into 3 size classes in each region, which are small size (1-59 rai), medium size (60-199 rai) and large size (more than 199 rai). The size classes ranging of the farms were is ranged by OCSB.

In the first step, the regions and locations which are most important for the product considered are identified. As a rule, these will be the main areas of production, but in some cases, they may be the regions with a particularly high potential for the expansion of production.

In the second step, experts are contacted with a sound knowledge of the local conditions, with access to regional accounting statistics and with good contacts to practical farming (e.g. technical advisors). With these experts, the main structural characteristics of the typical farms to be established are discussed (e.g. type of farm, size of farm). It is aimed to establish both an average size farm and a large-scale farm for each region. With the help of the local expert and of farmers managing farms that are similar to the typical farm to be established, the database for the typical farm is compiled. For the industry interview, the sampling of this study places emphasis on factories in the North, Northeastern and Central region of Thailand as there is a high number of sugar industry located.

The farm sample represents sugar cane farms in Thailand concerning the typical farm (irrigation/rainfed) as well as their regional distribution. As it can be seen from Table 3.1, the percentage of irrigated and rainfed farm in each region has been calculated from the number of farmers in irrigated and rainfed farm. Given there are 18 sampling farms for interview. The requirement of farm in irrigated area is 2 farms in Central region. The requirement of farm in rainfed area is 16 farms. From 16 farms, the farm sampling in rainfed area is 4 farms in Central region, 6 farms in Northeastern and 6 farms in North region. The farms in the Eastern region will not be involved in this study because of the small number of sugarcane farms and sugarcane area in this region.
Table 3.1  Farm samples, classified by irrigation and region

<table>
<thead>
<tr>
<th>Region</th>
<th>Total irrigated farms</th>
<th>% of total Farms by region</th>
<th>Farm sampling</th>
<th>Total rainfed farms</th>
<th>% of total farms by region</th>
<th>Farm sampling</th>
<th>Total number of farms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central</td>
<td>21,594</td>
<td>27.1</td>
<td>2</td>
<td>58,052</td>
<td>72.9</td>
<td>4</td>
<td>79,646</td>
</tr>
<tr>
<td>Northeastern</td>
<td>325</td>
<td>0.7</td>
<td>0</td>
<td>44,001</td>
<td>99.3</td>
<td>6</td>
<td>44,326</td>
</tr>
<tr>
<td>North</td>
<td>1,054</td>
<td>2.5</td>
<td>0</td>
<td>40,771</td>
<td>97.5</td>
<td>6</td>
<td>41,825</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>2**</td>
<td></td>
<td>16**</td>
<td></td>
<td></td>
<td>174,326</td>
</tr>
</tbody>
</table>

**Eastern** | 32        | 0.4          | 0           | 8,497               | 99.6                      | 6             | 8,529                |

**Source:** Own calculation from OCSB statistics (2004).

**Note:**  * Sugar farms in Eastern region were eliminated in this study.
  **Farm sampling requirement are 2 irrigated farms and 16 rainfed farms. Total requirement farms are 18 farms.

Table 3.2  Sampling procedure from number of sugarcane farmers and their shares in each region

<table>
<thead>
<tr>
<th>Region</th>
<th>Total number of sugarcane farms</th>
<th>Sample requirement</th>
<th>Sample obtained from interview</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Small</td>
<td>Medium</td>
<td>Large</td>
<td>Small</td>
</tr>
<tr>
<td>Central</td>
<td>70,262</td>
<td>7,250</td>
<td>2,134</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>(88)*</td>
<td>(9)*</td>
<td>(3)*</td>
<td>(0.55)**</td>
</tr>
<tr>
<td></td>
<td>(5.29)**</td>
<td>(5.29)**</td>
<td>(5)**</td>
<td>(1)**</td>
</tr>
<tr>
<td>Northeastern</td>
<td>37,083</td>
<td>5,838</td>
<td>1,405</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>(84)*</td>
<td>(13)*</td>
<td>(3)*</td>
<td>(0.79)**</td>
</tr>
<tr>
<td></td>
<td>(5.02)**</td>
<td>(5.02)**</td>
<td>(5)**</td>
<td>(1)**</td>
</tr>
<tr>
<td>North</td>
<td>34,348</td>
<td>5,678</td>
<td>1,799</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>(82)*</td>
<td>(14)*</td>
<td>(4)*</td>
<td>(0.81)**</td>
</tr>
<tr>
<td></td>
<td>(4.93)**</td>
<td>(4.93)**</td>
<td>(5)**</td>
<td>(1)**</td>
</tr>
<tr>
<td>Thailand</td>
<td><strong>Total</strong></td>
<td>15</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

**Source:** OCSB (2004) and own calculation.

**Note:** * Percent of number of farm, ** Proportional of typical farm, ***Sample size requirement
After that, data was sampled from the number of sugarcane farmers in each region. There are 3 regions. The minimum requirement from the typical farm approach is 6 farms in each region. Therefore, there are 18 required farms for the interview. The procedure to find typical farms began with the total number of sugarcane farmers in different size classes. For instance, the minimum sample in each region is 6 farms equal to 100 percent. In the Central region, the percentage of number of farmers are 88 percent. Therefore, the numbers of sample size requirement are 5 farms. From this study, farm data were collected equal to 29 farms (Table 3.2).

For the sugar industry, all factories were sent a questionnaire. There are 46 sugar factories in Thailand (Table 3.3). Within this number, there are 4 large factories, 16 medium size factories and 26 small size factories. The classification of the factories is based on data the average cane crushing capacity in tons per day. The maximum cane crushing capacity of the sugar factories is 35,526 tons per day. The minimum capacity is 380 tons per day. Large sugar factories have an average crushing capacity of more than 23,812 tons per day, medium size factories have an average crushing capacity between 12,096 and 23,811 tons per day and small size factories have the average capacity of less than 12,095 tons per day.

If around 20 percent of all factories in Thailand (46 factories) are included to be interviewed, a sample of 9 factories is required. To represent the real size structure of the sugar industry, the sample should contain one large factory, three medium factories and five small factories. Concerning the regional distribution the factory sample should consider three factories in Central region, three factories in Northeast region, two factories in North region and one factory in East region (Table 3.3).
Table 3.3  Structure of the sugar industry in Thailand

<table>
<thead>
<tr>
<th>Region</th>
<th>Size</th>
<th>Group</th>
<th>Number of factories</th>
<th>Factory name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central</td>
<td>Large</td>
<td>Mitr Phol</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tamaka</td>
<td>1</td>
<td>Tamaka</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thai Roong Ruang</td>
<td>1</td>
<td>Saraburi</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wang Kanai</td>
<td>3</td>
<td>Wangkanai, U-Thong, T.N.Sugar</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>Tamaka</td>
<td>1</td>
<td>New Krung Thai</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thai Roong Ruang</td>
<td>3</td>
<td>Karnchanaburi industry, Thai Sugar industry, Thai Multi-Sugar Industry</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other</td>
<td>6</td>
<td>Suphanburi Sugar Industry, Rajburi, Mitr Kasetr Industry, Prachuap Industry, Thai Sugar Mill, Pranburi</td>
</tr>
<tr>
<td></td>
<td>Small</td>
<td>Banpong</td>
<td>2</td>
<td>Banpong, Singburi</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tamaka</td>
<td>1</td>
<td>New Krung Thai</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thai Roong Ruang</td>
<td>3</td>
<td>Karnchanaburi industry, Thai Sugar industry, Thai Multi-Sugar Industry</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other</td>
<td>3</td>
<td>Suphanburi Sugar Industry</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Rajburi, Mitr Kasetr Industry, Prachuap Industry, Thai Sugar Mill, Pranburi</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>Northeast</td>
<td>Large</td>
<td>Other</td>
<td>1</td>
<td>Mitr Kalasin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mitr Phol</td>
<td>3</td>
<td>United Farm &amp; Industry, Mitr Phu Viang</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kumpawapi</td>
<td>2</td>
<td>Kumphawapi, Kaset Phol</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tamaka</td>
<td>1</td>
<td>Khon Kaen</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wang Kanai</td>
<td>1</td>
<td>Angvian (Ratchasima)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other</td>
<td>2</td>
<td>N.Y. Sugar, Rermudom</td>
</tr>
<tr>
<td></td>
<td>Small</td>
<td>Other</td>
<td>3</td>
<td>Burirum</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>E-Saan Sugar Industry, Saharuang</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>13</td>
</tr>
</tbody>
</table>
Table 3.3 Structure of the sugar industry in Thailand (continue)

<table>
<thead>
<tr>
<th>Region</th>
<th>Size</th>
<th>Group</th>
<th>Number of factories</th>
<th>Factory name</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>Large</td>
<td>Banpong</td>
<td>1</td>
<td>Nakornpetch</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thai Ekalak</td>
<td>1</td>
<td>Kaset Thai</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>Thai Ekalak</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Small</td>
<td>Thai Ekalak</td>
<td>1</td>
<td>Rumphol Nakhonsawan</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kampangpetch</td>
<td>2</td>
<td>Kampangpetch</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Chiangmai</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thai Roong Ruang</td>
<td>2</td>
<td>Thai Roong Ruang industry Phitsanulok</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other</td>
<td>2</td>
<td>Mae Wang Sugar Industry</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Uttaradit Sugar Industry</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>East</td>
<td>Large</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>Other</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Small</td>
<td>Tamaka</td>
<td>1</td>
<td>New Kwang Soon Lee</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thai Roong Ruang</td>
<td>1</td>
<td>Chonburi Sugar&amp; Trading</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other</td>
<td>2</td>
<td>Chonburi Sugar Industry</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Rayong Sugar</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Thailand (Total)</td>
<td>Large</td>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td></td>
<td>16</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Small</td>
<td></td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>46</td>
<td></td>
</tr>
</tbody>
</table>

Source: Office of the Cane and Sugar Board (2002)
Note: Sugar factories in Eastern region were eliminated in this study.
Large size $\geq 23,812$ tons per day
Medium size $= 12,096$-$23,811$ tons per day
Small size $\leq 12,095$ tons per day

The questionnaires were sent to 46 sugar factories. Only five of them responded. Among these, there are one large factory and four small factories (Table 3.4).
Table 3.4  Sugar factories interviewed

<table>
<thead>
<tr>
<th>No</th>
<th>Region</th>
<th>Size</th>
<th>Factory name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Northern</td>
<td>Large</td>
<td>A sugar factory</td>
</tr>
<tr>
<td>2</td>
<td>Northern</td>
<td>Small</td>
<td>B sugar factory</td>
</tr>
<tr>
<td>3</td>
<td>Central</td>
<td>Small</td>
<td>C sugar factory</td>
</tr>
<tr>
<td>4</td>
<td>Central</td>
<td>Small</td>
<td>D sugar factory</td>
</tr>
<tr>
<td>5</td>
<td>Northeastern</td>
<td>Small</td>
<td>E sugar factory</td>
</tr>
</tbody>
</table>

Source: Own survey.

Note: The calculation of factory size comes from maximum capacity deduct minimum capacity, and then divided by factory size.

In this study, the sugar factories will be named A, B, C, D and E factory.

3.4 Data analysis

The questioning of farmers was carried out by face-to-face interviews, which allowed very detailed insights in sugarcane growing in Thailand. The interviews of farmers were carried out between April and August in 2004. Each of them looks around three hours.

The factories preferred to answer the questionnaire in a written way. Unfortunately, the sugar industry was not willing to supply all the information which was desired and necessary for reliable statement on the situation of the sugar industry in Thailand.

After completing the field survey, the data were transferred from the questionnaires into worksheet as a database file. The variable names within the database file refer to the numbers of each question in the questionnaire.

In this study the measure of competitiveness of sugarcane farms and sugar industry is based on the analysis of production cost. The production cost analysis method will will be explained below.

Indicators of competitiveness are divided into technology, input costs, production economies, product quality and enterprise differentiation, advertising and promotion, and external factors. In this study, main indicators of competitiveness that have been applied are technology, input costs and production costs.

To ease the analysis, the data was divided into several sub-topics, in accordance with the structure of the questionnaire, such as farm structure, labor costs, and factor costs, capacities of machinery and agricultural tools, profitability of competing crops, irrigation and farm future strategies. The sugarcane farms were categorized into subgroups for analyses based on criteria such as region and farm size.
3.5 Farm costs calculation

In this study, the cost calculations are based on sugarcane production and its competing crops of sugarcane.

The analysis results in this study will be applied for the comparison of total costs and returns of sugarcane production. Total costs consist of expenses from the profit and loss account (cash costs, depreciation, etc.), and opportunity costs for farm-owned factors of production (family labour, own land, own capital). The estimation of these opportunity costs must be considered carefully because the potential income of farm owned factors of production in alternative uses is difficult to determine.

In the short run, the use of own production factors on a family farm can provide flexibility in the case of low returns when the family can chose to forgone income. However, in the long run opportunity costs must be considered because the potential successors of the farmer will, in most cases, make a decision on the alternative use of own production factors, in particular their own labour input, before taking over the farm. To indicate the effects of opportunity costs, we have to separate opportunity costs from the other costs in most of the figures.

For the estimation and calculations, Table 3.5 provides the definition and method of calculation for the most important economic indicators.

Table 3.5 Calculation of sugarcane production cost

<table>
<thead>
<tr>
<th>Item</th>
<th>Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total revenue</td>
<td>=  Sugarcane yield x Sugarcane price</td>
</tr>
<tr>
<td>Total variable costs</td>
<td>=  +  Seed</td>
</tr>
<tr>
<td></td>
<td>+  Fertilizer</td>
</tr>
<tr>
<td></td>
<td>+  Plant protection</td>
</tr>
<tr>
<td></td>
<td>+  Variable machinery costs</td>
</tr>
<tr>
<td></td>
<td>+  Contractor (land preparation, planting, harvest, loading and transportation costs)</td>
</tr>
<tr>
<td></td>
<td>+  Labour (permanent and seasonal labour)</td>
</tr>
<tr>
<td></td>
<td>+  Irrigation (energy, maintenance/repairs and fees)</td>
</tr>
<tr>
<td></td>
<td>+  Insurance (tractors, and trucks)</td>
</tr>
<tr>
<td></td>
<td>+  Fees (growers associations)</td>
</tr>
<tr>
<td></td>
<td>+  Loading and Transport costs</td>
</tr>
<tr>
<td></td>
<td>+  Other costs</td>
</tr>
<tr>
<td></td>
<td>+  Interest (circulation capital)</td>
</tr>
</tbody>
</table>

### Table 3.5 Calculation of sugarcane production cost (continue)

<table>
<thead>
<tr>
<th>Item</th>
<th>Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total fixed costs</strong></td>
<td>+ Depreciation (machinery and buildings)</td>
</tr>
<tr>
<td></td>
<td>+ Land rent</td>
</tr>
<tr>
<td></td>
<td>+ Taxes (land, trucks, tractors and other)</td>
</tr>
<tr>
<td></td>
<td>+ Insurances (tractors, trucks and social insurances for labour)</td>
</tr>
<tr>
<td></td>
<td>+ Other farm overheads</td>
</tr>
<tr>
<td></td>
<td>+ Interest (fixed assets)</td>
</tr>
<tr>
<td><strong>Total costs</strong></td>
<td>= + Total variable costs</td>
</tr>
<tr>
<td></td>
<td>+ Total fixed costs</td>
</tr>
<tr>
<td><strong>Opportunity costs</strong></td>
<td>= + Calculated labor costs (farm own labor)</td>
</tr>
<tr>
<td></td>
<td>+ Calculated land rent (farm own land)</td>
</tr>
<tr>
<td></td>
<td>+ Calculated interest (farm own capital)</td>
</tr>
<tr>
<td><strong>Economic cost</strong></td>
<td>= + Total cost</td>
</tr>
<tr>
<td></td>
<td>+ Opportunity costs</td>
</tr>
<tr>
<td><strong>Gross margin</strong></td>
<td>= + Total revenue</td>
</tr>
<tr>
<td></td>
<td>- Total variable costs</td>
</tr>
<tr>
<td><strong>Accounting profit</strong></td>
<td>= + Gross margin</td>
</tr>
<tr>
<td></td>
<td>- Total fixed costs</td>
</tr>
<tr>
<td><strong>Economic profit</strong></td>
<td>= + Accounting profit</td>
</tr>
<tr>
<td></td>
<td>- Opportunity costs</td>
</tr>
</tbody>
</table>

**Source:** Nott, Betz and Schwab (2006).

In this study, there are other important definitions related to farm comparison, which are used for calculation as follows.

**Total revenue**

Total revenue is the total money received from the sale of any given quantity of output. The total revenue is calculated by taking the price of the sale times the quantity sold. (Total revenue = price x quantity) (Biz 2002).
Total costs

Total Cost is the sum of the fixed cost and total variable cost for any given level of production, i.e., fixed cost plus total variable cost. Agricultural costs are often divided into various categories. Some of the more commonly used cost concepts are as follows.

Total fixed costs

Total fixed costs are the costs that do not change with the level of production. For example, the cost of owning a hog building is incurred regardless of whether the building is empty, half full of hogs, or overflowing with hogs.

Total variable costs

Total variable costs are the costs that change in direct proportion to changes in volume. Variable costs can be avoided by not producing. For example, the cost of feed to feed a steer is a variable cost. If the steer is not purchased, no feed costs are incurred, but the fixed costs of the livestock building are still incurred.

Opportunity costs

Opportunity costs are the cost of using a resource based on what it could have earned if used for the next best alternative. For example, the opportunity cost of farming your own land is the amount you could have received by renting it to someone else (Hofstrand 2005).

Profit

Profit calculates by gross income minus expenses.

Accounting profit

Accounting profit is the value that remains after all expenses except opportunity costs have been subtracted from gross income. It is the same as “net farm income”.

Economic profit

Economic profit is the value that remains after all costs, including the opportunity costs of the operator’s labor and capital, have been subtracted from gross income. It is as same as “return to management” (Hofstrand 2005).

Gross margin

A gross margin is calculated by taking variable costs away from the gross income earned from an enterprise. Gross margins are often reported on a per rai basis for cropping enterprises.

Strengths:

Gross margins, including standard budgets, are easy to calculate and their use is widespread. They are the first step in farm budgeting. For assessment of farms within an area, they are easy to measure and useful if limitations are recognized. There are a number of standard gross margin budgets and tools available that can be used as a starting point for calculation.

Weaknesses:

Gross margins can be misleading if estimated gross margins from major changes in farm practice are compared with current practices in isolation. Gross margins do not include fixed or overhead costs such as depreciation, machinery purchases, or permanent labour costs and comparison can be misleading if the proposed practice affects these factors. For major changes in farm operation and significant investments, resource requirements (including land, labour and capital), risk and cash flow should all be considered in addition to the effect on underlying farm profitability.

Comparability and consistency:

Gross margins are comparable when examining similar enterprises. They are consistently understood and calculated (HA 2005).

Gross margin is an indicator that measures the profitability to compare enterprises. It defined as the enterprise income less all enterprise costs. This can be expressed per rai. The profitability of the different farms is compared by using gross margins, where gross margin is defined as:
Gross margin = Enterprise returns – Enterprise variable costs

Figure 3.2 demonstrates the relationship between total farm gross margin and farm business profit. Gross margins are essentially the first step in calculating total farm business profit. Farm business profits (before tax) is arrived at by adding gross margins from all enterprises and taking away overhead costs, interest, lease charges and owner's salary (Montecillo, Jones and Gray 2006).

**Figure 3.2  How total farm gross margin relates to farm business profit**

Source: Montecillo, Jones and Gray (2006).
Break Even Point

The break-even point is where the total revenue equals the total cost. In other words, it is where profit equals zero. This point can be illustrated using a break-even chart. The break-even position will change according to changes in either the total costs or the total revenue. To explain how break-even analysis works, it is necessary to define the cost items.

Fixed costs

Fixed costs incurred after the decision to enter into a business activity is made, are not directly related to the level of production. Fixed costs include, but are not limited to, depreciation on equipment, interest costs, taxes and general overhead expenses. Total fixed costs are the sum of the fixed costs.

Variable costs

Variable costs change in direct relation to volume of output. They may include cost of goods sold or production expenses such as labor and power costs, feed, fuel, veterinary, irrigation and other expenses directly related to the production of a commodity or investment in a capital asset. Total variable costs (TVC) are the sum of the variable costs for the specified level of production or output. Average variable costs are the variable costs per unit of output or of TVC divided by units of output.
Figure 3.3  Break-even point analysis

Source: Biz (2002).

Total fixed costs are shown in Figure 3.3 by the broken horizontal line. Total fixed costs do not change as the level of production increases. Total variable costs of production are indicated by the broken line sloping upward, which illustrates that total variable costs increase directly as production increases.

The total cost line is the sum of the total fixed costs and total variable costs. The total cost line parallels the total variable cost line, but it begins at the level of the total fixed cost line.

The total income line is the gross value of the output. This is shown as a dotted line, starting at the lower left of the graph and slanting upward. At any point, the total income line is equivalent to the number of units produced multiplied by the price per unit.

The key point (break-even point) is the intersection of the total cost line and the total income line (Point P). A vertical line down from this point shows the level of production necessary to cover all costs. Production greater than this level generates positive revenue; losses are incurred at lower levels of production (Biz 2002).
4 SUGAR MARKET AND POLICY IN THAILAND

Sugarcane and sugar industry is recognized as a very important sector in Thailand. This chapter starts with the overviews of sugar market of Thailand in section 4.1 which show the details of sugar production of Thailand in section 4.1.1. Section 4.1.2 focuses on the quantity of sugar consumption of the world and domestic sugar consumption of Thailand. Section 4.1.3 goes into the details of the quantity of sugar exports of Thailand. Section 4.1.4 explains the quantities of sugar imports of Thailand. Section 4.2 presents the sugar policy with the export regulations in section 4.2.1. Section 4.2.2 describes the import regulations. Section 4.2.3 presents the interesting issue of government policy towards quota marketing system for sugarcane. Section 4.2.4 explores sugar price determination. Section 4.2.5 of this chapter introduces market channel for sugar industry of Thailand.

4.1 Sugar market

4.1.1 Sugar production

Thailand is the world’s sixth largest sugar producer and the twelfth largest consumer. Thai sugar production in 2002/2003 was a record of 7.3 million tons, an increase of 18.87 percent from the previous year. A small amount of Thailand’s sugar production is consumed in the country; the rest nearly 70% of production is supplied to the world market. Domestic consumption was 1.83 million tons, a decrease of about 14.86 percent from 1.80 million tons in the previous year, leaving plenty of room for sugar exports. In fact, Thailand imports sugar only in small quantity, but exports about 3.3-4.3 million tons per year, making it the world’s second largest exporter (OCSB 2004).

In the last decade, total quantity of sugar production has a fluctuated trend as it can be seen in Table 4.1. In the 1994/95 production year, total sugar production was 5.27 million tons. In the 2002/03 production year, Thai sugar production hit a record 7.3 million tons, up about 18.87 percent from 6.14 million tons in the previous year, because of ratoon cane and new planting sugarcane planted in 2001. The quantity of sugar production declined in some production year.

According to the share of sugar production classified by raw sugar\(^9\), plantation white sugar\(^10\) and refined sugar\(^11\), raw sugar production contain the

---

\(^9\) Raw sugar is what is left after processing the sugar cane to remove the molasses and refine the white sugar. The color is similar to light brown sugar but it’s texture is grainier (DSM, 2006). Raw sugar is a tan to brown, coarse granulated solid obtained on evaporation of clarified sugar cane juice. Raw sugar is processed from the cane at a sugar mill and then shipped to a refinery. It is about 98% sucrose. Raw sugar is not sold to consumers. The U.S.
highest share in production year 1994/95. Since the production year 1997/98, the share of raw sugar had decreased when compared to white sugar production. However, the share of raw sugar had grown up again to around 50% between the production year 2002/03 and 2004/05.

### Table 4.1  Development of sugar production quantity and share of raw sugar, white sugar, and refined sugar from production year 1994/95 to 2004/05

<table>
<thead>
<tr>
<th>Year</th>
<th>(1)</th>
<th>%</th>
<th>(2)</th>
<th>%</th>
<th>(3)</th>
<th>%</th>
<th>(4)</th>
<th>%</th>
<th>(5)</th>
<th>%</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994/95</td>
<td>2,883,971</td>
<td>54.8</td>
<td>1,519,925</td>
<td>28.9</td>
<td>861,346</td>
<td>16.4</td>
<td>-</td>
<td>0.0</td>
<td>5,265,241</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>1995/96</td>
<td>3,078,175</td>
<td>51.1</td>
<td>1,779,529</td>
<td>29.5</td>
<td>1,169,245</td>
<td>19.4</td>
<td>-</td>
<td>0.0</td>
<td>6,026,949</td>
<td>14.5</td>
<td></td>
</tr>
<tr>
<td>1996/97</td>
<td>2,824,163</td>
<td>48.7</td>
<td>2,053,668</td>
<td>35.4</td>
<td>924,834</td>
<td>16.0</td>
<td>-</td>
<td>0.0</td>
<td>5,802,665</td>
<td>-3.7</td>
<td></td>
</tr>
<tr>
<td>1997/98</td>
<td>1,513,168</td>
<td>37.0</td>
<td>1,968,812</td>
<td>48.1</td>
<td>612,515</td>
<td>15.0</td>
<td>-</td>
<td>0.0</td>
<td>4,094,494</td>
<td>-29.4</td>
<td></td>
</tr>
<tr>
<td>1998/99</td>
<td>2,155,383</td>
<td>41.5</td>
<td>2,144,358</td>
<td>41.3</td>
<td>892,598</td>
<td>17.2</td>
<td>-</td>
<td>0.0</td>
<td>5,192,339</td>
<td>26.8</td>
<td></td>
</tr>
<tr>
<td>1999/00</td>
<td>2,143,399</td>
<td>38.8</td>
<td>2,592,487</td>
<td>47.0</td>
<td>783,795</td>
<td>14.2</td>
<td>-</td>
<td>0.0</td>
<td>5,519,681</td>
<td>6.3</td>
<td></td>
</tr>
<tr>
<td>2000/01</td>
<td>2,166,657</td>
<td>43.5</td>
<td>2,074,871</td>
<td>41.7</td>
<td>611,639</td>
<td>12.3</td>
<td>129,064</td>
<td>2.6</td>
<td>4,982,231</td>
<td>-9.7</td>
<td></td>
</tr>
<tr>
<td>2001/02</td>
<td>2,254,806</td>
<td>36.7</td>
<td>2,666,521</td>
<td>43.4</td>
<td>1,210,573</td>
<td>19.7</td>
<td>9,154</td>
<td>0.2</td>
<td>6,141,054</td>
<td>23.3</td>
<td></td>
</tr>
<tr>
<td>2002/03</td>
<td>3,654,939</td>
<td>50.1</td>
<td>2,353,546</td>
<td>32.2</td>
<td>1,284,226</td>
<td>17.6</td>
<td>6,874</td>
<td>0.1</td>
<td>7,299,585</td>
<td>18.9</td>
<td></td>
</tr>
<tr>
<td>2003/04</td>
<td>3,699,009</td>
<td>52.9</td>
<td>2,279,623</td>
<td>32.6</td>
<td>1,004,955</td>
<td>14.4</td>
<td>5,349</td>
<td>0.1</td>
<td>6,988,936</td>
<td>-4.3</td>
<td></td>
</tr>
<tr>
<td>2004/05</td>
<td>2,621,797</td>
<td>50.5</td>
<td>1,898,482</td>
<td>36.6</td>
<td>660,264</td>
<td>12.7</td>
<td>6,814</td>
<td>0.1</td>
<td>5,187,356</td>
<td>-25.8</td>
<td></td>
</tr>
</tbody>
</table>

**Source:** OCSB (2005) and own modification.

**Note:** Unit in tons

(1) Raw sugar, (2) Plantation white sugar, (3) Refined sugar, (4) Other sugar, (5) Total, (6) Changes to previous year (%)

Thai sugar production is projected to grow up between 1994/95 and 2002/03, mainly due to the continued expansion of planted areas. Poor weather and insect problems have hindered cane yields in some years, leaving ample opportunity for yield growth.

---

Food and Drug Administration notes raw sugar is “unfit for direct use as food or as a food ingredient because of the impurities it ordinarily contains” (ASA, 2005).

10 Plantation white sugar means crystalline sugar that has not been refined and is intended for human consumption without further processing or refining (CBP, 2006). Plantation white sugar, also called Mill white sugar, Crystal sugar, or Superior sugar, is raw sugar, whose colored impurities have been bleached white by exposure to sulfur dioxide (DSM, 2006).

11 Refined sugar is the sugar that reduces to a fine, unmixed, or pure state; separate from extraneous matter or cleanse from impurities (Muhammad, 2003).
Figure 4.1 shows the trend of sugar production between the production year 1994/95 and 2004/05. It can be divided into three periods, that are 1994/95 to 1997/98, 1997/98 to 2000/01 and 2000/01 to 2004/05. In the first period, the total of sugar production has increased from 5.27 million tons at the beginning of period to more than 6 million tons and then it decline to 4.09 million tons in 1997/98 because of the economics crisis in Thailand. In the second period, the trend of sugar production has raised up from 4.09 million tons in 1997/98 to 5.52 million tons in 1999/00 because of the increase in planted area. After that, sugar production declined in 2000/01. In the last period, the quantity of sugar production had a dramatic increased from 4.98 million tons in 2000/01, and reached a peak of 7.30 million tons in 2002/03. Then, its trend declined to 5.19 million tons in 2004/05 due to the decrease in the planted area.

**Figure 4.1  Development of sugar production in Thailand from production year 1994/95 to 2004/05**

![Figure 4.1 Development of sugar production in Thailand from production year 1994/95 to 2004/05](image)

**Source:** OCSB (2005) and own modification.

Figure 4.2 presents that the share of the different sugar types produced has changed from 1994/95 to 2004/05. In 1994/95, raw sugar production was most important and amounted to 55%. Ordinary sugar accounted for 29%. Refined sugar was produced at 16%. Ten year later, in 2004/05, the share of sugar production in each type has changed: ordinary sugar production has increased to 37% and shows an increasing trend.
Figure 4.2  Comparisons of sugar production in production year 1994/95 and 2004/05

Production Year 1994/95

- Raw sugar: 55%
- White sugar: 29%
- Refined sugar: 16%

Production Year 2004/05

- Raw sugar: 50%
- White sugar: 37%
- Refined sugar: 13%

Source: OCSB (2005) and own modification.

4.1.2 Sugar consumption

Global sugar consumption in 2006 is forecasted to reach 148 million tons, an increase of 2 percent from 2005, due to an expected growth in consumption in the developing countries of the Far East and Latin America. Sugar consumption in developing countries is estimated to reach 100 million tons in 2006, in line with per capita GDP and population growth. Among developed countries, where
the demand had been relatively stable, consumption is forecasted to remain relatively unchanged in the EU, the Republic of Korea, and the United States.

From Figure 4.3, sugar consumption in Asia has increased dramatically between 1994/95 and 2003/04, driven by increased demand of the processing food sector, combined with declining production of artificial sweeteners in China and India. Growing consumption levels in Europe remain the same in that period but its consumption is still higher than that in North and Central America, Southern America, Africa, and Oceania.

**Figure 4.3 Development of sugar consumption in different parts of the world between 1994/95 and 2003/04**

Table 4.2 shows total consumption in tons compared to total production. Sugar consumption in Thailand has substantially grown during the past decade. Between production year 1994/95 and 2003/04, the annual growth in consumption has average about 4.05%. The share of domestic sugar consumption in sugar production amounts to 29.90% in the average between 1994/95 and 2003/04. This share increased by 0.20% annually. This reflects Thailand’s strong population growth and relatively strong growth in disposable incomes during the late 1990s.
Table 4.2 Development of sugar production and consumption in Thailand

<table>
<thead>
<tr>
<th>Year</th>
<th>Production (Tons)</th>
<th>Production Sugar Consumption (Tons)</th>
<th>Share of domestic sugar consumption in sugar production</th>
<th>Change in the share of domestic sugar consumption in sugar production</th>
<th>Growth of sugar consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994/95</td>
<td>5,265,241.27</td>
<td>1,370,260.49</td>
<td>26.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995/96</td>
<td>6,026,949.48</td>
<td>1,523,409.03</td>
<td>25.28</td>
<td>-0.75</td>
<td>11.18</td>
</tr>
<tr>
<td>1996/97</td>
<td>5,802,664.71</td>
<td>1,580,043.75</td>
<td>27.23</td>
<td>1.95</td>
<td>3.72</td>
</tr>
<tr>
<td>1997/98</td>
<td>4,094,494.32</td>
<td>1,711,633.13</td>
<td>41.80</td>
<td>14.57</td>
<td>8.33</td>
</tr>
<tr>
<td>1998/99</td>
<td>5,192,338.81</td>
<td>1,698,123.68</td>
<td>32.70</td>
<td>-9.10</td>
<td>-0.79</td>
</tr>
<tr>
<td>1999/00</td>
<td>5,519,681.13</td>
<td>1,644,887.73</td>
<td>29.80</td>
<td>-2.90</td>
<td>-3.13</td>
</tr>
<tr>
<td>2000/01</td>
<td>4,982,230.78</td>
<td>1,681,475.85</td>
<td>33.75</td>
<td>3.95</td>
<td>2.22</td>
</tr>
<tr>
<td>2001/02</td>
<td>6,141,054.35</td>
<td>1,809,918.17</td>
<td>29.47</td>
<td>-4.28</td>
<td>7.64</td>
</tr>
<tr>
<td>2002/03</td>
<td>7,299,585.13</td>
<td>1,831,565.54</td>
<td>25.09</td>
<td>-4.38</td>
<td>1.20</td>
</tr>
<tr>
<td>2003/04</td>
<td>6,988,935.95</td>
<td>1,943,238.32</td>
<td>27.80</td>
<td>2.71</td>
<td>6.10</td>
</tr>
<tr>
<td>Average</td>
<td>5,731,317.59</td>
<td>1,679,455.57</td>
<td>29.90</td>
<td>0.20</td>
<td>4.05</td>
</tr>
</tbody>
</table>

Source: OCSB (2004) and own modification.

Figure 4.4 demonstrates the development of sugar consumption in Thailand. It presents that domestic demand on sugar consumption is likely to continue to expand rapidly.

Figure 4.4 Development of sugar consumption in Thailand

Source: OCSB (2004) and own modification.
Sugar production of Thailand has contributed to domestic consumption with around 30% of total sugar production in each year. The rest of around 70% can be exported to foreign countries (Netayarak, 1994). The demand for domestic consumption amounts to almost 2 million tons annually and has the tendency to increase. There are 2 types of domestic sugar consumption in Thailand, which are plantation white sugar and refined sugar. In proportion of domestic sugar consumption, 70% is plantation white sugar and the rest of 30% is refined sugar. Income from sugar sales on the domestic market amounted to around 22 billion Baht in 2004, with average wholesale sugar prices of around 12 Baht/ton. (Table 4.3).

Table 4.3  Domestic sugar consumption and income from sugar sales in Thailand, classified by plantation white sugar and refined sugar

<table>
<thead>
<tr>
<th>Year</th>
<th>Domestic consumption (Tons)</th>
<th>Income (Baht)</th>
<th>Average price* (Baht/ton)</th>
<th>Domestic consumption (Tons)</th>
<th>Income (Baht)</th>
<th>Average price* (Baht/ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>695,706</td>
<td>7,644,730,357</td>
<td>10,989</td>
<td>327,624</td>
<td>3,795,584,101</td>
<td>11,585</td>
</tr>
<tr>
<td>1991</td>
<td>746,593</td>
<td>8,203,472,644</td>
<td>10,988</td>
<td>354,783</td>
<td>4,110,139,385</td>
<td>11,585</td>
</tr>
<tr>
<td>1993</td>
<td>841,150</td>
<td>9,243,453,014</td>
<td>10,989</td>
<td>425,719</td>
<td>4,939,506,546</td>
<td>11,603</td>
</tr>
<tr>
<td>1994</td>
<td>729,830</td>
<td>8,020,011,592</td>
<td>10,989</td>
<td>640,431</td>
<td>7,438,269,295</td>
<td>11,615</td>
</tr>
<tr>
<td>1995</td>
<td>1,006,129</td>
<td>11,061,915,411</td>
<td>10,995</td>
<td>517,280</td>
<td>5,998,614,303</td>
<td>11,597</td>
</tr>
<tr>
<td>1996</td>
<td>1,052,420</td>
<td>11,573,034,686</td>
<td>10,997</td>
<td>527,624</td>
<td>6,117,807,176</td>
<td>11,595</td>
</tr>
<tr>
<td>1997</td>
<td>1,157,671</td>
<td>12,730,574,574</td>
<td>10,997</td>
<td>553,962</td>
<td>6,422,445,806</td>
<td>11,594</td>
</tr>
<tr>
<td>1998</td>
<td>1,176,675</td>
<td>12,943,311,505</td>
<td>11,000</td>
<td>521,449</td>
<td>6,074,588,299</td>
<td>11,649</td>
</tr>
<tr>
<td>1999</td>
<td>1,164,897</td>
<td>12,805,186,830</td>
<td>10,993</td>
<td>479,991</td>
<td>5,591,893,256</td>
<td>11,650</td>
</tr>
<tr>
<td>2000</td>
<td>1,266,626</td>
<td>14,458,857,474</td>
<td>11,415</td>
<td>414,850</td>
<td>5,008,166,331</td>
<td>12,072</td>
</tr>
<tr>
<td>2001</td>
<td>1,357,296</td>
<td>15,965,107,440</td>
<td>11,762</td>
<td>452,622</td>
<td>5,642,156,612</td>
<td>12,466</td>
</tr>
<tr>
<td>2002</td>
<td>1,371,531</td>
<td>16,128,891,614</td>
<td>11,760</td>
<td>460,035</td>
<td>5,734,561,693</td>
<td>12,466</td>
</tr>
<tr>
<td>2003</td>
<td>1,453,433</td>
<td>17,095,209,424</td>
<td>11,762</td>
<td>489,805</td>
<td>6,105,667,880</td>
<td>12,466</td>
</tr>
<tr>
<td>2004</td>
<td>1,397,457</td>
<td>16,434,605,434</td>
<td>11,760</td>
<td>453,861</td>
<td>5,657,604,271</td>
<td>12,466</td>
</tr>
</tbody>
</table>

Source: OCSB (2005).

Note: Income is the income from domestic sales of sugar.
*Wholesale price.
Table 4.3  Domestic sugar consumption and income from sugar sales in Thailand, classified by plantation white sugar and refined sugar (continue)

<table>
<thead>
<tr>
<th>Year</th>
<th>Domestic consumption (Tons)</th>
<th>Income (Baht)</th>
<th>Average price (Baht/ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>1,023,330</td>
<td>11,440,314,457</td>
<td>11,180</td>
</tr>
<tr>
<td>1991</td>
<td>1,101,376</td>
<td>12,313,612,028</td>
<td>11,180</td>
</tr>
<tr>
<td>1992</td>
<td>1,170,307</td>
<td>13,084,764,334</td>
<td>11,181</td>
</tr>
<tr>
<td>1993</td>
<td>1,266,870</td>
<td>14,182,959,559</td>
<td>11,195</td>
</tr>
<tr>
<td>1994</td>
<td>1,370,260</td>
<td>15,458,280,887</td>
<td>11,281</td>
</tr>
<tr>
<td>1995</td>
<td>1,523,409</td>
<td>17,060,529,714</td>
<td>11,199</td>
</tr>
<tr>
<td>1996</td>
<td>1,580,044</td>
<td>17,690,841,862</td>
<td>11,196</td>
</tr>
<tr>
<td>1997</td>
<td>1,711,633</td>
<td>19,153,020,379</td>
<td>11,190</td>
</tr>
<tr>
<td>1998</td>
<td>1,698,124</td>
<td>19,017,899,804</td>
<td>11,199</td>
</tr>
<tr>
<td>1999</td>
<td>1,644,888</td>
<td>18,397,080,086</td>
<td>11,184</td>
</tr>
<tr>
<td>2000</td>
<td>1,681,476</td>
<td>19,467,023,805</td>
<td>11,577</td>
</tr>
<tr>
<td>2001</td>
<td>1,809,918</td>
<td>21,607,264,051</td>
<td>11,938</td>
</tr>
<tr>
<td>2002</td>
<td>1,831,566</td>
<td>21,863,453,307</td>
<td>11,937</td>
</tr>
<tr>
<td>2003</td>
<td>1,943,238</td>
<td>23,200,877,304</td>
<td>11,939</td>
</tr>
<tr>
<td>2004</td>
<td>1,851,318</td>
<td>22,092,209,704</td>
<td>11,933</td>
</tr>
</tbody>
</table>

**Source:** OCSB (2005).

**Note:** Income is the income from domestic sales of sugar.

By inspection of Table 4.4, the consumption of sugar is classified into two parts. First part is direct consumption or the consumption by households. Households demand sugar for daily cooking or consumption in restaurants. Second part is indirect consumption or the consumption by the industrial sector, for instance, food and beverage industry, beer industry, milk and milk product industry, candy industry, etc.

Household’s sugar consumption has a higher share than industry’s consumption. 70% of sugar sales go to households, while 30% of sugar sale go to industry. From 1991 to 2004, the share of household consumption has decreased slightly from 74.67% in 1991 to 68.34% in 2004, while the share of industry consumption has increased from 25 to 32%. The trend of sugar used by industry has increased from 0.278 million tons in 1991 to 0.586 million ton in 2004.
Table 4.4 Development of household and industry consumption of sugar in Thailand

<table>
<thead>
<tr>
<th>Year</th>
<th>Domestic consumption (Tons)</th>
<th>Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Household consumption</td>
<td>Industry consumption</td>
</tr>
<tr>
<td>1991</td>
<td>822,396.62</td>
<td>278,979.12</td>
</tr>
<tr>
<td>1992</td>
<td>854,603.87</td>
<td>315,703.05</td>
</tr>
<tr>
<td>1993</td>
<td>936,353.00</td>
<td>330,516.69</td>
</tr>
<tr>
<td>1994</td>
<td>1,022,136.08</td>
<td>348,124.41</td>
</tr>
<tr>
<td>1995</td>
<td>1,183,327.60</td>
<td>340,081.43</td>
</tr>
<tr>
<td>1996</td>
<td>1,204,483.28</td>
<td>375,560.47</td>
</tr>
<tr>
<td>1997</td>
<td>1,217,014.48</td>
<td>494,618.65</td>
</tr>
<tr>
<td>1998</td>
<td>991,095.08</td>
<td>707,028.60</td>
</tr>
<tr>
<td>1999</td>
<td>938,544.57</td>
<td>706,343.16</td>
</tr>
<tr>
<td>2000</td>
<td>985,990.95</td>
<td>695,484.90</td>
</tr>
<tr>
<td>2001</td>
<td>1,251,660.27</td>
<td>558,257.90</td>
</tr>
<tr>
<td>2002</td>
<td>1,265,714.14</td>
<td>565,851.40</td>
</tr>
<tr>
<td>2003</td>
<td>1,327,480.02</td>
<td>615,758.30</td>
</tr>
<tr>
<td>2004</td>
<td>1,265,192.35</td>
<td>586,125.15</td>
</tr>
</tbody>
</table>

Source: OCSB (2005).

Table 4.5 shows that mostly white sugar is consumed in Thailand. Around 70% of quantities of domestic sugar sales are plantation white sugar sale, while 30% are refined sugar sales. From 1991 to 2004, the share of plantation white sugar has increased from 68 to 75%, while the share of refined sugar has decreased from 32 to 25%.
Table 4.5 Development of white sugar and refined sugar consumption in Thailand

<table>
<thead>
<tr>
<th>Year</th>
<th>Plantation White sugar</th>
<th>Refined sugar</th>
<th>Total</th>
<th>Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>White sugar Refined sugar</td>
<td>White sugar Refined sugar</td>
<td>White sugar</td>
<td>Share (%)</td>
</tr>
<tr>
<td>1991</td>
<td>746,592.81 354,782.93</td>
<td>1,101,375.74</td>
<td>67.79 : 32.21</td>
<td></td>
</tr>
<tr>
<td>1992</td>
<td>792,887.62 377,419.30</td>
<td>1,170,306.91</td>
<td>67.75 : 32.25</td>
<td></td>
</tr>
<tr>
<td>1993</td>
<td>841,147.40 425,722.29</td>
<td>1,266,869.69</td>
<td>66.40 : 33.60</td>
<td></td>
</tr>
<tr>
<td>1994</td>
<td>729,829.57 640,430.92</td>
<td>1,370,260.49</td>
<td>53.26 : 46.74</td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>1,006,129.32 517,279.71</td>
<td>1,523,409.03</td>
<td>66.04 : 33.96</td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>1,052,420.21 527,623.54</td>
<td>1,580,043.75</td>
<td>66.61 : 33.39</td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>1,157,671.46 553,961.68</td>
<td>1,711,633.13</td>
<td>67.64 : 32.36</td>
<td></td>
</tr>
<tr>
<td>1998</td>
<td>1,176,675.08 521,448.61</td>
<td>1,698,123.68</td>
<td>69.29 : 30.71</td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td>1,164,896.89 479,990.85</td>
<td>1,644,887.73</td>
<td>70.82 : 29.18</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>1,266,625.58 414,850.27</td>
<td>1,681,475.85</td>
<td>75.33 : 24.67</td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>1,357,296.41 452,621.77</td>
<td>1,809,918.17</td>
<td>74.99 : 25.01</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>1,371,530.91 460,034.63</td>
<td>1,831,565.54</td>
<td>74.88 : 25.12</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>1,453,433.03 489,805.29</td>
<td>1,943,238.32</td>
<td>74.79 : 25.21</td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>1,397,456.50 453,861.00</td>
<td>1,851,317.50</td>
<td>75.48 : 24.52</td>
<td></td>
</tr>
</tbody>
</table>

Source: OCSB (2005) and own calculation.

Table 4.6 shows that the industry sector with the highest sugar consumption is the beverage industry, which accounts for 37.13% of industrial sugar consumption. The rest are food industry, milk product industry, Drugs industry, bakery industry, and candy industry, which account for 23.96%, 21.24%, 8.86%, 5.89%, and 2.92% respectively.
Table 4.6  Development of domestic sugar sales to indirect consumption classified by type of industrial sector

<table>
<thead>
<tr>
<th>Year</th>
<th>Beverage (Tons)</th>
<th>Bread (Include liquor and Beer) (Tons)</th>
<th>Food (Tons)</th>
<th>Milk product (Tons)</th>
<th>Candy (Tons)</th>
<th>Drug and other (Tons)</th>
<th>Total (Tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>120,962.79</td>
<td>20,189.93</td>
<td>57,657.90</td>
<td>52,192.65</td>
<td>8,376.40</td>
<td>19,599.45</td>
<td>278,979.12</td>
</tr>
<tr>
<td>1992</td>
<td>127,257.17</td>
<td>40,317.30</td>
<td>65,025.28</td>
<td>52,874.05</td>
<td>8,702.10</td>
<td>21,527.15</td>
<td>315,703.05</td>
</tr>
<tr>
<td>1993</td>
<td>130,539.90</td>
<td>43,541.25</td>
<td>66,103.59</td>
<td>62,224.35</td>
<td>8,484.35</td>
<td>19,623.25</td>
<td>330,516.69</td>
</tr>
<tr>
<td>1994</td>
<td>146,855.80</td>
<td>32,966.40</td>
<td>63,527.31</td>
<td>74,947.75</td>
<td>6,952.70</td>
<td>22,874.45</td>
<td>348,124.41</td>
</tr>
<tr>
<td>1995</td>
<td>137,853.55</td>
<td>47,632.51</td>
<td>39,935.95</td>
<td>73,880.90</td>
<td>3,819.10</td>
<td>36,959.42</td>
<td>340,081.43</td>
</tr>
<tr>
<td>1996</td>
<td>135,482.35</td>
<td>51,514.60</td>
<td>46,970.65</td>
<td>79,924.87</td>
<td>7,329.70</td>
<td>54,338.30</td>
<td>375,560.47</td>
</tr>
<tr>
<td>1997</td>
<td>166,747.04</td>
<td>73,310.01</td>
<td>68,149.15</td>
<td>98,203.35</td>
<td>8,613.15</td>
<td>79,595.95</td>
<td>494,618.65</td>
</tr>
<tr>
<td>1998</td>
<td>193,657.95</td>
<td>21,653.70</td>
<td>212,125.85</td>
<td>150,071.20</td>
<td>22,614.55</td>
<td>106,905.35</td>
<td>707,028.60</td>
</tr>
<tr>
<td>1999</td>
<td>188,507.40</td>
<td>20,455.00</td>
<td>246,553.81</td>
<td>140,631.25</td>
<td>21,664.00</td>
<td>88,531.70</td>
<td>706,343.16</td>
</tr>
<tr>
<td>2000</td>
<td>252,625.00</td>
<td>13,181.70</td>
<td>193,383.80</td>
<td>165,402.10</td>
<td>20,507.90</td>
<td>50,384.40</td>
<td>695,484.90</td>
</tr>
<tr>
<td>2001</td>
<td>225,129.10</td>
<td>6,647.90</td>
<td>141,560.10</td>
<td>128,933.40</td>
<td>18,688.80</td>
<td>37,298.60</td>
<td>558,257.90</td>
</tr>
<tr>
<td>2002</td>
<td>219,927.00</td>
<td>9,163.40</td>
<td>157,424.90</td>
<td>132,309.90</td>
<td>21,858.30</td>
<td>25,167.90</td>
<td>565,851.40</td>
</tr>
<tr>
<td>2003</td>
<td>259,107.80</td>
<td>12,649.60</td>
<td>170,143.30</td>
<td>127,010.70</td>
<td>19,582.50</td>
<td>27,264.40</td>
<td>615,758.30</td>
</tr>
<tr>
<td>2004</td>
<td>264,385.05</td>
<td>14,218.00</td>
<td>129,302.35</td>
<td>130,653.10</td>
<td>24,723.95</td>
<td>22,842.70</td>
<td>586,125.15</td>
</tr>
</tbody>
</table>

Average (Tons) 183,502.71 29,102.95 118,418.85 104,947.11 14,422.68 43,779.50 494,173.80

Average Share (%) 37.13 5.89 23.96 21.24 2.92 8.86 100.00

Source: OCSB (2005) and own calculation.

4.1.3 Sugar exports

Sugar has become increasingly important in growing Asian regional trade because of freight cost advantages and reliable services. According to trade sources, sugar moves from Thailand to the major regional buyers China, Japan, the Republic of Korea, and Malaysia, with freight advantages over the Western Hemisphere sugar making it difficult for exporters from the latter region to compete (FAO 2004).
In 2004, almost 50% of Thailand’s sugar exports were raw sugar exports (Table 4.7). More than 98% of Thailand’s sugar exports went to the Asian market (4.57 million tons). This is true for all types of sugar. While Europe, America and Asia mostly bought raw sugar, Oceania and Africa mostly bought refined sugar.

The average export prices, which could be achieved in 2004, amounted to 7,983, 7,891 and 6,249 Baht/tons for plantation white sugar, refined sugar and raw sugar respectively. The highest sugar prices could be achieved in Oceania, America and Europe. The lowest prices were achieved by sugar exports to Africa.

Table 4.7 Thailand’s sugar exports to the world market, classified by raw sugar, white sugar and refined sugar in 2004

<table>
<thead>
<tr>
<th>Continent</th>
<th>Asia</th>
<th>Africa</th>
<th>Oceania</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw sugar</td>
<td>Quantity (Tons)</td>
<td>2,239,234</td>
<td>23,732</td>
</tr>
<tr>
<td></td>
<td>Value (Baht)</td>
<td>13,880,218,710</td>
<td>159,130,536</td>
</tr>
<tr>
<td></td>
<td>Price (Baht/tons)</td>
<td>6,199</td>
<td>6,705</td>
</tr>
<tr>
<td></td>
<td>% of quantity</td>
<td><strong>49.04</strong></td>
<td>35.39</td>
</tr>
<tr>
<td>Plantation white sugar</td>
<td>Quantity (Tons)</td>
<td>1,366,605</td>
<td>10,405</td>
</tr>
<tr>
<td></td>
<td>Value (Baht)</td>
<td>10,913,012,152</td>
<td>78,419,892</td>
</tr>
<tr>
<td></td>
<td>Price (Baht/tons)</td>
<td>7,985</td>
<td>7,537</td>
</tr>
<tr>
<td></td>
<td>% of quantity</td>
<td>29.93</td>
<td>15.52</td>
</tr>
<tr>
<td>Refined sugar</td>
<td>Quantity (Tons)</td>
<td>959,909</td>
<td>32,925</td>
</tr>
<tr>
<td></td>
<td>Value (Baht)</td>
<td>7,594,954,106</td>
<td>229,627,355</td>
</tr>
<tr>
<td></td>
<td>Price (Baht/tons)</td>
<td>7,912</td>
<td>6,974</td>
</tr>
<tr>
<td></td>
<td>% of quantity</td>
<td>21.02</td>
<td><strong>49.10</strong></td>
</tr>
<tr>
<td>Total</td>
<td>Quantity (Tons)</td>
<td>4,565,748</td>
<td>67,062</td>
</tr>
<tr>
<td></td>
<td>Value (Baht)</td>
<td>32,388,184,967</td>
<td>467,177,783</td>
</tr>
<tr>
<td></td>
<td>Price (Baht/tons)</td>
<td>7,094</td>
<td>6,966</td>
</tr>
<tr>
<td></td>
<td>% of quantity</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

% of total quantity 98.03 1.44 0.09

Source: OCSB (2004) and own calculation.
Table 4.7  Thailand sugar exports to the world market, classified by raw sugar, white sugar and refined sugar in 2004 (continue)

<table>
<thead>
<tr>
<th>Continent</th>
<th>America</th>
<th>Europe</th>
<th>Total (Tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw sugar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quantity (Tons)</td>
<td>14,244</td>
<td>5,000</td>
<td>2,282,605</td>
</tr>
<tr>
<td>Value (Baht)</td>
<td>189,863,808</td>
<td>30,535,000</td>
<td>14,263,236,026</td>
</tr>
<tr>
<td>Price (Baht/tons)</td>
<td>13,329</td>
<td>6,107</td>
<td>6,249</td>
</tr>
<tr>
<td>% of quantity</td>
<td>94.28</td>
<td>96.34</td>
<td>49.01</td>
</tr>
<tr>
<td>Plantation white sugar</td>
<td>864</td>
<td>-</td>
<td>1,378,002</td>
</tr>
<tr>
<td>Value (Baht)</td>
<td>7,255,779</td>
<td>-</td>
<td>11,000,015,373</td>
</tr>
<tr>
<td>Price (Baht/tons)</td>
<td>8,398</td>
<td>-</td>
<td>7,983</td>
</tr>
<tr>
<td>% of quantity</td>
<td>5.72</td>
<td>0.00</td>
<td>29.59</td>
</tr>
<tr>
<td>Refined sugar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value (Baht)</td>
<td>-</td>
<td>2,197,529</td>
<td>7,865,669,676</td>
</tr>
<tr>
<td>Price (Baht/tons)</td>
<td>-</td>
<td>11,566</td>
<td>7,891</td>
</tr>
<tr>
<td>% of quantity</td>
<td>0.00</td>
<td>3.66</td>
<td>21.40</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quantity (Tons)</td>
<td>15,108</td>
<td>5,190</td>
<td>4,657,441</td>
</tr>
<tr>
<td>Value (Baht)</td>
<td>197,119,587</td>
<td>32,732,529</td>
<td>33,128,921,075</td>
</tr>
<tr>
<td>Price (Baht/tons)</td>
<td>13,047</td>
<td>6,307</td>
<td>7,113</td>
</tr>
<tr>
<td>% of quantity</td>
<td>100</td>
<td>100</td>
<td>100.00</td>
</tr>
</tbody>
</table>

% of total quantity

Source: OCSB (2004) and own calculation.

Table 4.8 shows top ten's Thailand sugar export to the world market between 1992 and 2004. Sugar exports went to Asian markets, with shipments to the Indonesia, Japan, South Korea, China, Malaysia, Russia, India, Iran, Sri Lanka and Jordan. Sizeable shipments are made annually to smaller markets in the region such as Pakistan, Philippines, Cambodia, Yemen, Egypt, Bangladesh, Vietnam, Taiwan, Singapore and Syria. The largest non-Asian market during 1992 to 2004 was Russia, which combined took average 148,063 tons.

Thailand and Australia compete as the largest raw sugar exporters in the Asia and Pacific region, the Republic of Korea is Asia's largest refined sugar exporter. Malaysia, Singapore, and China also export refined sugar. Recent trends suggest that Thailand is gaining ground on some of its competitors in the
export of raw sugar. For example, as a member of Association of Southeast Asian Nations (ASEAN), Thailand’s recent refined sugar exports to the Philippines entered duty-free whereas refined sugar from Australia faced a 20% ad valorem duty (FAO, 2004).

Thailand is now firmly established as one of the world's leading sugar exporting countries. During 1995/96 to 2005/06, sugar exports ranged between 2.3 and 5.1 million tons and averaged 3.80 million tons per year. This upward trend in exports has been spurred by growing regional markets, higher domestic production, low internal consumption relative to total production, and favorable export policies.

Sugar export earnings have been an expanding contributor to the agricultural sector's robust earnings growth. For the period 1992-94, Thailand's total exports averaged US $38.3 billion of which the agricultural sector amounted to 27% of the total or US $10.3 billion. For 1995, sugar export earnings were a record US $1.2 billion, up 50% from 1994, and were surpassed in dollar terms only by fishery products, animal products and by-products, and cereal grains, mainly rice (FAO, 2006).

Table 4.8  Top ten's Thailand sugar export to the world market between 1992 and 2004

<table>
<thead>
<tr>
<th>Year</th>
<th>Indonesia</th>
<th>Japan</th>
<th>South Korea</th>
<th>China</th>
<th>Malaysia</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>302,670</td>
<td>830,269</td>
<td>742,128</td>
<td>81,708</td>
<td>340,649</td>
</tr>
<tr>
<td>1993</td>
<td>141,230</td>
<td>658,152</td>
<td>498,510</td>
<td>41,000</td>
<td>206,976</td>
</tr>
<tr>
<td>1994</td>
<td>84,000</td>
<td>655,586</td>
<td>356,490</td>
<td>455,483</td>
<td>179,963</td>
</tr>
<tr>
<td>1995</td>
<td>307,000</td>
<td>517,190</td>
<td>371,540</td>
<td>1,421,800</td>
<td>284,494</td>
</tr>
<tr>
<td>1996</td>
<td>662,900</td>
<td>718,769</td>
<td>607,416</td>
<td>487,842</td>
<td>358,600</td>
</tr>
<tr>
<td>1997</td>
<td>1,244,200</td>
<td>685,895</td>
<td>692,900</td>
<td>230,004</td>
<td>375,097</td>
</tr>
<tr>
<td>1998</td>
<td>749,629</td>
<td>679,548</td>
<td>159,415</td>
<td>87,092</td>
<td>85,116</td>
</tr>
<tr>
<td>1999</td>
<td>807,329</td>
<td>515,889</td>
<td>200,159</td>
<td>33,000</td>
<td>135,521</td>
</tr>
<tr>
<td>2000</td>
<td>1,241,146</td>
<td>727,812</td>
<td>313,682</td>
<td>93,039</td>
<td>274,206</td>
</tr>
<tr>
<td>2001</td>
<td>776,488</td>
<td>675,229</td>
<td>249,362</td>
<td>400,514</td>
<td>325,427</td>
</tr>
<tr>
<td>2002*</td>
<td>508,934</td>
<td>160,620</td>
<td>60,006</td>
<td>137,892</td>
<td>157,655</td>
</tr>
<tr>
<td>Average</td>
<td>620,502</td>
<td>620,451</td>
<td>386,510</td>
<td>315,398</td>
<td>247,610</td>
</tr>
</tbody>
</table>

Source: OCSB (2005) and own calculation.

Note:  * Data in year 2002 was the data from January to July.
Table 4.8 Top ten's Thailand sugar export to the world market between 1992 and 2004 (continue)

<table>
<thead>
<tr>
<th>Year</th>
<th>Russia</th>
<th>India</th>
<th>Iran</th>
<th>Sri Lanka</th>
<th>Jordan</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>74,000</td>
<td>-</td>
<td>160,200</td>
<td>94,341</td>
<td>268,600</td>
</tr>
<tr>
<td>1993</td>
<td>34,050</td>
<td>-</td>
<td>54,000</td>
<td>92,192</td>
<td>156,100</td>
</tr>
<tr>
<td>1994</td>
<td>-</td>
<td>236,850</td>
<td>42,000</td>
<td>169,149</td>
<td>-</td>
</tr>
<tr>
<td>1995</td>
<td>43,600</td>
<td>-</td>
<td>105,000</td>
<td>91,300</td>
<td>-</td>
</tr>
<tr>
<td>1996</td>
<td>45,000</td>
<td>-</td>
<td>336,000</td>
<td>88,500</td>
<td>42,000</td>
</tr>
<tr>
<td>1997</td>
<td>83,000</td>
<td>24,000</td>
<td>110,850</td>
<td>77,000</td>
<td>-</td>
</tr>
<tr>
<td>1998</td>
<td>76,000</td>
<td>13,500</td>
<td>-</td>
<td>18,000</td>
<td>-</td>
</tr>
<tr>
<td>1999</td>
<td>457,200</td>
<td>270,005</td>
<td>70,020</td>
<td>99,930</td>
<td>21,695</td>
</tr>
<tr>
<td>2000</td>
<td>284,200</td>
<td>8,000</td>
<td>6,400</td>
<td>181,604</td>
<td>-</td>
</tr>
<tr>
<td>2001</td>
<td>72,081</td>
<td>-</td>
<td>-</td>
<td>56,500</td>
<td>4,000</td>
</tr>
<tr>
<td>2002*</td>
<td>311,500</td>
<td>-</td>
<td>63,300</td>
<td>77,902</td>
<td>26,000</td>
</tr>
<tr>
<td>Average</td>
<td>148,063</td>
<td>110,471</td>
<td>105,308</td>
<td>95,129</td>
<td>86,399</td>
</tr>
</tbody>
</table>

Source: OCSB (2005) and own calculation.
Note: * Data in year 2002 was the data from January to July.

Table 4.9 reveals the composition of sugar exports including raw and white sugar. Sugar exported from Thailand consisted of raw sugar and white sugar. The share of raw sugar export was significantly higher than the share of white sugar exports. In production year 1995/96, raw sugar exports amounted to 2.78 million tons or 75 percent of total exports. For the period 1995/96 to 2005/06, raw sugar exports averaged about 2.23 million tons per year, while white sugar exports averaged 1.57 million tons.

Thailand’s major raw sugar export competitors include Brazil, Australia, Cuba, and South Africa. Export quantity fluctuated depending on changes in production and consumption of sugar on domestic market.

Actually, the residual amount of sugar from domestic consumption will be exported to the world market. According to the data in the long run, sugar export quantity increased every year from 3.69 million tons with a value of 28,383 million Baht in 1995/96 and reached a peak at 5.06 million tons with a value of 38,432 million Baht in 2003/04. Since then the figure turned down to about 3.04 million tons as the planted area was reduced.

However, the export trend of white sugar increased gradually from 24.7% of total exports in 1995/96 to 47.9% of total exports in 2005/06 because the
export price of white sugar is higher than raw sugar and some of sugar importing countries has lacked the factory to transform raw sugar to white sugar (Netayarak et al 1994).

Table 4.9  Quantity of sugar export classified by raw sugar and white sugar between production year 1995/96 and 2005/06

<table>
<thead>
<tr>
<th>Production year</th>
<th>Raw sugar</th>
<th>White sugar</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quantity (ton)</td>
<td>Share (%)</td>
<td>Value (Million Bath)</td>
</tr>
<tr>
<td>1995/96</td>
<td>2,780,900</td>
<td>75.3</td>
<td>20,690.11</td>
</tr>
<tr>
<td>1996/97</td>
<td>2,854,960</td>
<td>65.7</td>
<td>19,288.73</td>
</tr>
<tr>
<td>1997/98</td>
<td>2,524,700</td>
<td>61.6</td>
<td>17,984.65</td>
</tr>
<tr>
<td>1998/99</td>
<td>1,386,990</td>
<td>60.0</td>
<td>14,371.25</td>
</tr>
<tr>
<td>1999/00</td>
<td>1,997,622</td>
<td>61.1</td>
<td>11,349.53</td>
</tr>
<tr>
<td>2000/01</td>
<td>2,321,692</td>
<td>56.8</td>
<td>13,366.87</td>
</tr>
<tr>
<td>2001/02</td>
<td>2,218,286</td>
<td>68.3</td>
<td>20,098.16</td>
</tr>
<tr>
<td>2002/03</td>
<td>2,059,789</td>
<td>51.1</td>
<td>12,935.12</td>
</tr>
<tr>
<td>2003/04</td>
<td>2,549,512</td>
<td>50.3</td>
<td>17,624.89</td>
</tr>
<tr>
<td>2004/05</td>
<td>2,235,205</td>
<td>48.6</td>
<td>13,975.68</td>
</tr>
<tr>
<td>2005/06</td>
<td>1,583,634</td>
<td>52.1</td>
<td>13,422.54</td>
</tr>
<tr>
<td>Average</td>
<td>2,228,480</td>
<td>58.7</td>
<td>15,918.87</td>
</tr>
</tbody>
</table>

Source: OCSB (2005).

4.1.4 Sugar imports

Most of the imported sugar of Thailand was the beet sugar, which was imported from Japan, Great Britain and Belgium for domestic production. According to the data from Table 4.10, it is only small quantities of sugar that are imported to Thailand. In the year 2000, there was no sugar imported but there was high demand on sugar import in 2003, with an amount of 100.04 tons.
Table 4.10 Sugar imports under the agreement of the World Trade Organization (WTO) between 1995 and 2003

<table>
<thead>
<tr>
<th>Year</th>
<th>Total imports (Tons)</th>
<th>Average price (Baht/ton)</th>
<th>Value (Baht)</th>
<th>Country of Origin</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>2.00</td>
<td>23,959.00</td>
<td>47,918.00</td>
<td>Japan</td>
</tr>
<tr>
<td>1996</td>
<td>9.00</td>
<td>58,830.54</td>
<td>529,474.86</td>
<td>Japan, Great Britain</td>
</tr>
<tr>
<td>1997</td>
<td>4.00</td>
<td>12,646.88</td>
<td>50,587.52</td>
<td>Japan</td>
</tr>
<tr>
<td>1998</td>
<td>17.32</td>
<td>104,549.60</td>
<td>1,810,799.07</td>
<td>Japan, Belgium</td>
</tr>
<tr>
<td>1999</td>
<td>20.25</td>
<td>10,468.71</td>
<td>211,991.38</td>
<td>Australia, Belgium</td>
</tr>
<tr>
<td>2000</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2002</td>
<td>5.36</td>
<td>52,409.48</td>
<td>281,103.49</td>
<td>Belgium, United Arab Emirates</td>
</tr>
<tr>
<td>2003</td>
<td>100.04</td>
<td>17,502.70</td>
<td>1,750,970.11</td>
<td>China, France</td>
</tr>
</tbody>
</table>

Source: OCSB (2005).

4.2 Sugar policy

4.2.1 Export regulations and quota system

Government policy towards sugar exports has remained generally unchanged in recent years. Each season, the Government estimates production, internal needs, and export commitments and then allocates sugar supplies to three quotas:

Quota A – domestic: This quota, all refined sugar, is allocated to mills by the Government at the start of each season on the basis of production capacity. The sugar is sold to approve wholesalers at a fixed price. The Quota A for 2000/01 was set at 1.7 million tons.

Quota B - long-term contracts: This 800,000 ton contract, all raw sugar, is held by several trade houses. They sell on behalf of the Thailand Cane and Sugar Corporation (TCSC) which has overall responsibility for pricing and selling raw sugar under this quota. Half of the amount is allocated to international sugar brokers and the other half is sold to local millers for export.

Quota C - exportable surplus: The mills undertake their own pricing of this sugar, but must pay growers at least the Quota B sales price achieved by the TCSC. These sales must be made by licensed exporting companies. For 2000/01 the Quota C was set at 2.49 million tons of raw or refined sugar (FAO 1997).

12 The announcement of sugar price in Thailand is fixed price which is regulated from Office of Cane and Sugar Board.
While licenses to build new factories are not currently being issued, new quota tonnages are annually allocated to mill groups with the largest C Quota production to encourage mills to crush as much cane as possible. Mills must meet production targets for Quotas A and B, before exporting under Quota C. Quota C (export) sales are usually concluded 6 months prior to the start of the crushing season in November by seven authorized exporting companies: The Thai Sugar Trading Corp., Ltd. (TSTC), Thailand Sugar Corp., Ltd. (TSC), Siam Sugar Export Corp., Ltd. (SSEC), the Sugar Industry Trading Co., Ltd. (SITCO), K.S.L. Export Trading (KSL), Pacific Sugar Corp., Ltd. (PSC) and TISS Co., Ltd. which belongs to the Thai Identity Sugar Group of Companies which started its sugar exports in 1995 (FAO 1997).

Table 4.11 illustrates the development of different types of sugar quota. It is worth noting that quota C has the highest amount with 2.5 million tons in the production year 2000/01. Quota B or long term contracts quota has lowest quantity.

<table>
<thead>
<tr>
<th>Production Year</th>
<th>Quota A</th>
<th>Quota B</th>
<th>Quota C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1983/84</td>
<td>650,000</td>
<td>611,450</td>
<td>901,078</td>
</tr>
<tr>
<td>1984/85</td>
<td>700,000</td>
<td>600,000</td>
<td>1,171,401</td>
</tr>
<tr>
<td>1985/86</td>
<td>650,000</td>
<td>630,000</td>
<td>1,211,343</td>
</tr>
<tr>
<td>1986/87</td>
<td>702,926</td>
<td>630,000</td>
<td>1,202,271</td>
</tr>
<tr>
<td>1987/88</td>
<td>790,000</td>
<td>600,000</td>
<td>1,201,288</td>
</tr>
<tr>
<td>1988/89</td>
<td>840,000</td>
<td>600,000</td>
<td>2,461,637</td>
</tr>
<tr>
<td>1989/90</td>
<td>980,000</td>
<td>600,000</td>
<td>1,769,109</td>
</tr>
<tr>
<td>1990/91</td>
<td>1,080,000</td>
<td>600,000</td>
<td>2,162,922</td>
</tr>
<tr>
<td>1991/92</td>
<td>1,210,000</td>
<td>600,000</td>
<td>3,073,845</td>
</tr>
<tr>
<td>1992/93</td>
<td>1,280,000</td>
<td>800,000</td>
<td>1,537,848</td>
</tr>
<tr>
<td>1993/94</td>
<td>1,325,000</td>
<td>800,000</td>
<td>1,697,945</td>
</tr>
<tr>
<td>1994/95</td>
<td>1,500,000</td>
<td>800,000</td>
<td>2,968,890</td>
</tr>
<tr>
<td>1995/96</td>
<td>1,650,000</td>
<td>800,000</td>
<td>3,543,518</td>
</tr>
<tr>
<td>1996/97</td>
<td>1,670,000</td>
<td>800,000</td>
<td>3,346,476</td>
</tr>
<tr>
<td>1997/98</td>
<td>1,700,000</td>
<td>800,000</td>
<td>1,594,494</td>
</tr>
<tr>
<td>1998/99</td>
<td>1,750,000</td>
<td>800,000</td>
<td>2,642,339</td>
</tr>
<tr>
<td>1999/00</td>
<td>1,650,000</td>
<td>800,000</td>
<td>3,070,081</td>
</tr>
<tr>
<td>2000/01</td>
<td>1,700,000</td>
<td>800,000</td>
<td>2,488,030</td>
</tr>
</tbody>
</table>

4.2.2 Import regulations

The government import policy on sugar follows the WTO agreement, which is limited to a 65 percent tariff rate under the quota of 13,760 metric tons in 2004. But sugar import during 2001-2004 was likely being insignificant due to sufficient available domestic supply. In 2004, the out-of-quota tariff rate is 94%, a percentage point decline from the previous year (Table 4.12).

Table 4.12 Actual sugar imported and tariff for government import policy on sugar follows WTO agreement during 1995 to 2004

<table>
<thead>
<tr>
<th>Year</th>
<th>Quota (Tons)</th>
<th>Actual imported (Tons)</th>
<th>Tariff quota (%)</th>
<th>Tariff out of quota (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>13,105.00</td>
<td>2.00</td>
<td>65</td>
<td>103</td>
</tr>
<tr>
<td>1996</td>
<td>13,178.00</td>
<td>9.00</td>
<td>65</td>
<td>102</td>
</tr>
<tr>
<td>1997</td>
<td>13,251.00</td>
<td>4.00</td>
<td>65</td>
<td>101</td>
</tr>
<tr>
<td>1998</td>
<td>13,323.00</td>
<td>17.32</td>
<td>65</td>
<td>100</td>
</tr>
<tr>
<td>1999</td>
<td>13,396.00</td>
<td>20.00</td>
<td>65</td>
<td>99</td>
</tr>
<tr>
<td>2000</td>
<td>13,469.00</td>
<td>-</td>
<td>65</td>
<td>98</td>
</tr>
<tr>
<td>2001</td>
<td>13,542.00</td>
<td>6.44</td>
<td>65</td>
<td>97</td>
</tr>
<tr>
<td>2002</td>
<td>13,614.00</td>
<td>5.36</td>
<td>65</td>
<td>96</td>
</tr>
<tr>
<td>2003</td>
<td>13,687.00</td>
<td>100.00</td>
<td>65</td>
<td>95</td>
</tr>
<tr>
<td>2004</td>
<td>13,760.00</td>
<td>2.10</td>
<td>65</td>
<td>94</td>
</tr>
</tbody>
</table>

Source: Department of Business Economic (2005).

4.2.3 Quota marketing system for sugarcane

A quota marketing and production system prevails in order to ensure sufficient and regular supply to the sugar cane factories. Quota marketing is based on contracts signed between factories and representatives (or middlemen) from sugarcane growers groups. The groups are established by and sign a contract with the quota head. The distribution of the quota from the 46 factories to quota heads is based on the capacity of each group of farmers, which is judged from the planting area and group members. The sugar factories partly control the amount of the production by providing credit for crop production to growers.

However, a fundamental point is to understand that not all sugar cane producers are alike: farming systems appear quite differentiated and can be conveniently grouped under a typology (Srijantr 1998): the large capitalistic farm (quota head) and the small farm type (look rai).
The “quota head” type represents large-scale sugar cane plantations. The quota head manages the quota contract for the sugar mill factories. The quota head commonly has farms with cane area of around 100 rai or more and generally owns the corresponding machinery such as tractors, trucks, etc. The quota head manages wage labor for crop plantation, crop care and harvest.

The “look rai”, or contracting farmer is the farmer who depends upon the sugarcane quota head. The quota head often provides farm inputs to his “look rai”, to enable them to produce enough quantity of sugarcane for their quota. The farm inputs usually supplied are capital, fertilizer, herbicide, insecticide. Other hired services include four wheel tractor services for land preparation, truck for sugar cane transportation and labor for harvesting (Srijantr et al 1999).

Sugarcane farmers sell their product to sugar millers by these methods:

First is selling sugarcane directly to sugar mills. In this case, farmers require a great sugarcane farm area to meet the quota. These farmers sign contracts with the sugar mill managers.

Second is selling through the quota of the quota man. Most farmers are able to plant sugarcane at a minimum amount and sell their products directly to sugar mills (Figure 4.5).

**Figure 4.5  Market channel of sugarcane in Thailand**

**Source:** Manarangsan and Kaewthep (1987).

**Note:** BAAC is Bank for Agriculture and Agricultural Cooperatives.
The sugarcane market in Thailand was a buyer’s market before the establishment of the Sugarcane Association. The sugarcane price was specified by sugar mill managers. Sugarcane farmers had no power to bargain against the sugar mill managers because sugar mills are the only markets for sugarcane products. Moreover, farmers make a forward transaction contract with the sugar mill managers. Furthermore, the sugarcane easily loses its sugar content, so after cultivation it should be processed as quickly as possible.

Besides, some sugarcane sellers owe promotion money to their contracted managers. They have to sell their product to the managers in order to pay back the debts.

After the Sugarcane Farmer Association was established, the structure of sugarcane price determination changed. The price determination is made by the result of price bargaining between representatives of the Sugarcane Farmers Association and the representatives of private mills. If they cannot agree on a final sugar price, a government official will try to compromise them. The most convenient time for making contracts is around October to November, which is about one month before the new sugar production season begins (Biz Dimension 2006).

**Figure 4.6  Sugarcane market structure**

The total of sugarcane farmers

- Sugarcane Farmer Association
- Cane Farmer Agricultural Cooperative
- Independent farmers

Quota farmers or Quota men

- Quota men with large farm
- Quota men with small farm

Non-quota farmers

- Quota men without farm or capitalist

The sugar mill

**Source:** Biz Dimension (2006).
In figure 4.6, there are three groups of sugarcane farmers: members of the Sugarcane Farmer Association, members of the Farmer Agricultural Cooperative and independent sugarcane farmers who are not members of either body. These groups can be further separated into farmers with or without quotas from sugar millers (Biz Dimension 2006).

### 4.2.4 Sugar cane price determination

In 1982/83 crop year, the net proceeds sharing system of 70:30 was first introduced. This new sugarcane payment system will do away with arguments and bargaining between the sugarcane growers and millers beginning of the season as ever before. Now sugarcane is sold milled and the sugar sold domestically and exported, and the net from sugar sold are shared between the sugarcane growers and the millers. In principle, there will now be no need for the sugarcane growers and millers or quarrel with each other, for under the new sharing system, both will share in the proceeds at the end of the season. The proceeds are shared with 70% of the total net proceeds going to the sugarcane growers and 30% to the millers (Figure 4.7).

The Sugar Act of 1984 introduced a revenue-sharing scheme of growers and mills. Under the scheme, growers receive 70% of the revenue from domestic and export sales of sugar and molasses, less costs and taxes, and mills earn the remaining 30%. Upon delivery of cane to mills, growers receive an initial payment calculated on a base price negotiated by the government.

This advance payment is not to be less than 80% of the share expected at the end of the season. If the actual “season average-price” is lower than the base price, the difference is adjusted the following season.

The Sugar Act of 1984 also provides for a 21-member Cane and Sugar Board composed of nine growers, seven government, and five mill representatives, which controls cane production levels, encourages improvement in quality, and seeks lower production costs to make exports more competitive. One recent target set by the Board was to limit cane production to zones within 100 kilometres of a mill to lower transportation cost (Biz Dimension 2006).
The calculation of sugarcane price has two parts. First, the calculation of sugarcane price without considering the commercial cane sugar\textsuperscript{13} (C.C.S.) of sugarcane. Second, the calculation of sugarcane price with the consideration of sugarcane C.C.S. The calculation of sugarcane price in second part will vary

\textsuperscript{13} C.C.S. is the symbol for “commercial cane sugar”.

\textbf{Source:} OCSB (1990a).
according to the C.C.S. value. If the sugarcane has high C.C.S, the price will be high. After summation the revenue from Molasses sale per ton will be the final sugarcane price, which sugarcane farmers will earn (Petchworakul 2001).

The formula in calculation sugarcane price followed to the Cane and sugar act in 1968 (Satitwityanan et.al 2004). The formula the 70: 30 sharing system is as follows:

\[
P_c = \frac{0.7(R_1 + R_2)}{Q_c} \tag{4.1}
\]

Where
- \(P_c\) = Sugarcane price (Baht/ton)
- \(R_1\) = Net proceeds from domestic sale
- \(R_2\) = Net proceeds from export
- \(Q_c\) = Total sugarcane quantity to be milled in each season

Net proceeds= Gross proceeds minus sale expenses and taxes

The present formula in calculation sugarcane price follows to the Cane and sugar act in 1984. The formula is as follows:

\[
P_c = P_1 + P_2 \times CCS + M \tag{4.2}
\]

Where
- \(P_c\) = Sugarcane price per metric ton
- \(P_1\) = Sugarcane price
- \(P_2\) = Sugarcane price vary to C.C.S.
- \(M\) = Net income proceed from sale of Molasses per ton
- \(CCS\) = Commercial cane sugar

Under the sharing system, the sugarcane price is divided into two stages (Figure 4.8):
Figure 4.8 Sugarcane price determinations under the revenue sharing system

(1) Preliminary sugarcane price

At the beginning of the season, forecast of revenues from domestic sale and export and sugarcane quantity will have to be made. Calculation of expected revenues from forecasted figures will be made accordingly. Then preliminary a sugarcane price is to be announced in early December each year (at the beginning of crop year).

(2) Final sugarcane price

At the end of the following September during which domestic sale, export’s revenue as well as sugarcane quantity milled in the season are known, calculation of actual revenues derived from the actual domestic sale, export’s
revenue as well as sugarcane quantity will be made. Then the final sugarcane price will be announced in October each year (OCSB 2003).

The sugarcane price is one of the important factors, which directly affects both change in sugarcane planted area and sugarcane production. On the one hand, if the sugarcane price is higher, the sugarcane farmers will earn more total revenue and profit if production costs do not significantly increase. This induces them to increase sugarcane production not only by increasing planted area but also by yield per rai. On the other hand, if the sugarcane price is lower, the sugarcane farmer will earn less and deficit. This will result in decreasing sugarcane production by reducing the planted area or fertilizer use (Netayarak 1994).

The sugarcane price is divided into preliminary price and final price. According to the statistic from OCSB in Figure 4.9, the final sugarcane price was generally announced higher than preliminary sugarcane price, except in the production year 1998/99 and 2001/02. Both sugarcane prices show upward trends. However, sugarcane prices have fluctuated in some years.

**Figure 4.9  Development of sugarcane prices**

![Sugarcane price chart](image)

**Source:** OCSB (2005).

Table 4.13 shows the development of sugarcane prices and the difference between preliminary price and final price. The lowest level of the Thai final sugarcane price was in the production year 1991/1992, accounting for 480 Baht per ton or 9.6 Euro per ton as a result of weak demand or oversupply in the
market. Meanwhile the highest level of the final price was achieved in 2004/05, equal to 657 Baht per ton or 14.9 Euro per ton.

Table 4.13  Development of sugarcane prices from 1991/92 to 2000/01

<table>
<thead>
<tr>
<th>Production year</th>
<th>Preliminary price*</th>
<th>Final price</th>
<th>Different</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Baht/ton)</td>
<td>(Euro/ton)**</td>
<td>(Baht/ton)</td>
</tr>
<tr>
<td>1991/92</td>
<td>399.00</td>
<td>7.98</td>
<td>480.00</td>
</tr>
<tr>
<td>1992/93</td>
<td>420.00</td>
<td>8.40</td>
<td>499.30</td>
</tr>
<tr>
<td>1993/94</td>
<td>490.00</td>
<td>9.80</td>
<td>533.01</td>
</tr>
<tr>
<td>1994/95</td>
<td>520.00</td>
<td>10.40</td>
<td>569.27</td>
</tr>
<tr>
<td>1995/96</td>
<td>500.00</td>
<td>10.00</td>
<td>537.61</td>
</tr>
<tr>
<td>1996/97</td>
<td>500.00</td>
<td>10.00</td>
<td>560.85</td>
</tr>
<tr>
<td>1997/98</td>
<td>600.00</td>
<td>12.00</td>
<td>702.59</td>
</tr>
<tr>
<td>1998/99</td>
<td>500.00</td>
<td>10.00</td>
<td>484.59</td>
</tr>
<tr>
<td>1999/00</td>
<td>450.00</td>
<td>9.00</td>
<td>478.27</td>
</tr>
<tr>
<td>2000/01</td>
<td>600.00</td>
<td>12.00</td>
<td>688.71</td>
</tr>
<tr>
<td>2001/02</td>
<td>530.00</td>
<td>10.60</td>
<td>520.49</td>
</tr>
<tr>
<td>2002/03</td>
<td>500.00</td>
<td>10.00</td>
<td>533.82</td>
</tr>
<tr>
<td>2003/04</td>
<td>465.00</td>
<td>10.40</td>
<td>568.00</td>
</tr>
<tr>
<td>2004/05</td>
<td>620.00</td>
<td>10.42</td>
<td>657.00</td>
</tr>
</tbody>
</table>

Source: OCSB (2005).

Note:  
* Price at 10 C.C.S. level.  
** Exchange rate: 1 Baht = 0.02 Euro or 1 Euro = 50 Baht.

Moreover, there is a report that reveals that the government is also a main factor for the Thai sugar prices. The government directly negotiates annual sugarcane prices with growers and mills. It also operates a credit program under which farmers can borrow an amount equivalent to their advance for sugar delivered to mills, at below-market interest rates.

To sum up, the price of sugarcane and sugar has been the only thing that every party involved is concerned with. Since the government acts as the mediator according to the Cane and Sugar Act 1984, it always becomes the target of all sorts of demands from the parties involved. In the last few years, both pre-season and post-season sugarcane price announcements have become a political issue. Since the private parties involved in the price-formulating system
do not include consumers or sugar-users, there are tendencies that the private parties ask for price raise, since this would only benefit them (Biz Dimension 2006).

4.2.5 Market channel for sugar

In Thailand, centrifugal sugar can be divided into: 1) Raw sugar, the end product of the cane mill and the raw material for the refinery. 2) Brown or raw washed sugar. 3) Plantation white sugar, the most common sugar product manufactured by modern sugar mills. It is both directly consumed and processed by industries. 4) Refined sugar, one of the purest known types of organic subsistence. It contains 99.96% of sucrose. 5) Special sugar, processed from plantation white sugar or refined sugar. The market for Thai sugar can be divided into the domestic market and the foreign market. The domestic market structure is shown in the following diagram (Figure 4.10):

**Figure 4.10 Domestic Sugar Market Structure**

The diagram indicates that sugar mill managers sell their sugar to agents and to some big industries, such as soft drink and food canneries. The agents sell sugar to their sub-agents, wholesalers and to exporters. The sub agents sell their sugar to wholesalers, retailers and to small industries. The wholesalers sell their sugar to the retailers and the retailers sell to consumers.
5 SUGARCANE PRODUCTION AND SUGAR INDUSTRY IN THAILAND

In the following on the one hand, the structure of sugar cane production and the sugar industry in Thailand is described. On the other hand, the process of sugar cane growing and processing is explained.

The studies of sugarcane farms are generally appearing parallel to sugar industry because its structure and markets are close related and linked together. At present, sugarcane growers and sugar industries are facing the same problems of oversupply and falling prices.

To solve and improve these issues, sugarcane farms need to be analyzed separately from the sugar industry. Therefore, this chapter covers the structure and market of sugarcane farms. Firstly, the structures of sugarcane production will be presented in section 5.1. Secondly, the process of sugarcane growing is being discussed in section 5.2. Thirdly, the structure of the sugar industry in Thailand is also covered in section 5.3. Finally, the process of sugar production will be explained in section 5.4.

5.1 Structure of sugarcane production

Sugarcane is a major field crop in Thailand; it covers an area of one million hectares during the crop year 2004/05. Sugarcane production in Thailand has increased largely from 1982/1983 crop year to present as a result of expanding of planted area (Table 5.1). In 2002/03 sugar cane production reached a peak in area (7.44 million rai), production (74.07 million tons) and yield (9.95 tons/rai).

From the parallel trends between area and production, one can easily assume that capital (seeds, fertilizer, other chemicals, machines, and so on) and labour have contributed only minimally to improve sugarcane yields, leaving land as the most important factor in sugarcane production.
In the 1990s, the annual rate of growth in sugarcane area has increased by one percent in the average. The production trend in Figure 5.1 can be divided into three periods: 1982/83 to 1987/88, 1988/89 to 1997/1998 and 1998/1999 to present. In the former period, the trend was somewhat flat, and then turned upward after 1987/88 because there was the expansion of the number of sugar factories and sugar cane area. Between crop year 1987/88 and 2002/2003, sugarcane production has increased and fluctuated. In 2002/03, crop production reached a peak of more than 70 million tons due to good rain condition, and then

### Table 5.1 Development of sugar cane production in Thailand

<table>
<thead>
<tr>
<th>Production year</th>
<th>Sugarcane planted area (million rai)</th>
<th>Sugarcane production (million tons)</th>
<th>Average yield of sugarcane (Tons/rai)</th>
<th>(Tons/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982/83</td>
<td>4.08</td>
<td>23.92</td>
<td>5.86</td>
<td>36.62</td>
</tr>
<tr>
<td>1983/84</td>
<td>3.52</td>
<td>23.09</td>
<td>6.57</td>
<td>44.04</td>
</tr>
<tr>
<td>1984/85</td>
<td>3.80</td>
<td>25.05</td>
<td>6.58</td>
<td>41.16</td>
</tr>
<tr>
<td>1985/86</td>
<td>3.84</td>
<td>24.00</td>
<td>6.25</td>
<td>39.06</td>
</tr>
<tr>
<td>1986/87</td>
<td>3.46</td>
<td>24.44</td>
<td>7.06</td>
<td>44.10</td>
</tr>
<tr>
<td>1987/88</td>
<td>3.75</td>
<td>27.19</td>
<td>7.25</td>
<td>45.30</td>
</tr>
<tr>
<td>1988/89</td>
<td>4.13</td>
<td>36.70</td>
<td>8.89</td>
<td>55.53</td>
</tr>
<tr>
<td>1989/90</td>
<td>4.56</td>
<td>33.56</td>
<td>7.36</td>
<td>46.00</td>
</tr>
<tr>
<td>1990/91</td>
<td>5.28</td>
<td>40.56</td>
<td>7.68</td>
<td>48.00</td>
</tr>
<tr>
<td>1991/92</td>
<td>6.06</td>
<td>47.50</td>
<td>7.84</td>
<td>48.99</td>
</tr>
<tr>
<td>1992/93</td>
<td>6.14</td>
<td>34.71</td>
<td>5.65</td>
<td>35.33</td>
</tr>
<tr>
<td>1993/94</td>
<td>6.03</td>
<td>37.57</td>
<td>6.23</td>
<td>38.94</td>
</tr>
<tr>
<td>1994/95</td>
<td>5.64</td>
<td>49.31</td>
<td>8.74</td>
<td>54.64</td>
</tr>
<tr>
<td>1995/96</td>
<td>6.24</td>
<td>57.69</td>
<td>9.25</td>
<td>57.79</td>
</tr>
<tr>
<td>1996/97</td>
<td>5.89</td>
<td>56.19</td>
<td>9.54</td>
<td>59.63</td>
</tr>
<tr>
<td>1997/98</td>
<td>5.75</td>
<td>42.20</td>
<td>7.34</td>
<td>45.86</td>
</tr>
<tr>
<td>1998/99</td>
<td>5.89</td>
<td>50.06</td>
<td>8.49</td>
<td>53.08</td>
</tr>
<tr>
<td>1999/00</td>
<td>5.62</td>
<td>53.13</td>
<td>9.46</td>
<td>59.13</td>
</tr>
<tr>
<td>2000/01</td>
<td>5.81</td>
<td>48.65</td>
<td>8.38</td>
<td>52.37</td>
</tr>
<tr>
<td>2001/02</td>
<td>6.04</td>
<td>59.49</td>
<td>9.85</td>
<td>61.56</td>
</tr>
<tr>
<td>2002/03</td>
<td>7.44</td>
<td>74.07</td>
<td>9.95</td>
<td>62.19</td>
</tr>
<tr>
<td>2003/04</td>
<td>7.00</td>
<td>64.48</td>
<td>9.21</td>
<td>57.59</td>
</tr>
<tr>
<td>2004/05</td>
<td>6.34</td>
<td>47.82</td>
<td>7.54</td>
<td>47.11</td>
</tr>
</tbody>
</table>

**Source:** OCSB (2004).  
**Note:** 1 rai = 0.16 ha
it declined significantly to less than 50 million tons in crop year 2004/05 as the result of the declined price of sugar cane.

**Figure 5.1 Development of sugarcane production and planted area in Thailand**

This growth in sugarcane production is primarily explained by the change in crushing capacities and the move of sugar factories from the Central and East region to North and Northeastern region (Netayarak 1992).

**Figure 5.2 Development of the sugarcane yield from 1982/83 to 2003/04 in Thailand**

**Source:** OCSB (2004).

**Source:** OCSB (2005).
Figure 5.2 presents sugarcane yields from 1982/83 to 2003/04. In the 1980s, the annual sugarcane yield averaged 6.96 tons/rai. After that, in the 1990s, the annual average yield increased to 8.26 tons/rai. During the period of 2000/01 to 2003/04, the annual yield amounted to 9.51 tons/rai in the average.

In Thailand sugarcane is grown throughout the country. The sugarcane planted area in Thailand can be divided into four regions that are, North, Central, East and Northeast. There is no sugarcane production in the south of Thailand. The planted area is concentrated in Central and some parts in Northeast and North region (Figure 5.3).

Figure 5.3 Geographic information system (GIS) map of the sugarcane area in production year 2003

Source: OCSB (2005) and own modification.

In the 1960s, most sugar cane area was found in the Central and Eastern region of Thailand (Figure 5.4). In the 1970s more than 60% of sugar cane was planted in the Central region. While sugar cane area in the Eastern region decreased continuously since the 1960s, it was clearly extended in the Northeastern region.
Currently, most of the sugar cane area is found in the Northeastern region (more than 40%), followed by the Central region (around 35%).

**Figure 5.4  Development of the share of sugarcane planted area by region**

![Graph showing the development of the share of sugarcane planted area by region from 1961/62 to 2004/05.](image)

Source: OCSB (2004) and own calculation.

Table 5.2 shows that Northeast, Central and North have a high percentage of sugarcane area. Almost 75% of the sugarcane area is located in the Northeast and Central region, while North and East region have a sugarcane area of only 19% and 6%, respectively.

**Table 5.2  Sugarcane area in Thailand by region in production year 2004/2005**

<table>
<thead>
<tr>
<th>Region</th>
<th>Sugarcane area</th>
<th>Sugarcane area (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(rai)</td>
<td>(ha)</td>
</tr>
<tr>
<td>Northeast</td>
<td>2,723,886</td>
<td>435,822</td>
</tr>
<tr>
<td>Central</td>
<td>2,021,076</td>
<td>323,372</td>
</tr>
<tr>
<td>North</td>
<td>1,207,038</td>
<td>193,126</td>
</tr>
<tr>
<td>East</td>
<td>391,372</td>
<td>62,620</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6,343,372</strong></td>
<td><strong>1,014,940</strong></td>
</tr>
</tbody>
</table>

Source: OCSB (2005).
Sugarcane farmers are mostly small-scale farmers, who sell their whole harvests to generate incomes. The data in table 5.3 demonstrate that small farmers with less than 59 rai account for 84.4%, which is a significant majority of the sugarcane producers in Thailand. Medium size sugarcane farms between 60 and 199 rai account for 12.0%, whereas farmers who have a sugarcane area of more than 199 rai account for 3.6%.

<table>
<thead>
<tr>
<th>Region</th>
<th>Small (&lt; 59 rai)</th>
<th>Medium (60-199 rai)</th>
<th>Large (&gt; 199 rai)</th>
<th>Total Number of cane farms</th>
<th>Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of farms</td>
<td>Share (%)</td>
<td>Number of farms</td>
<td>Share (%)</td>
<td>Number of farms</td>
</tr>
<tr>
<td>North</td>
<td>34,348</td>
<td>82.1</td>
<td>5,678</td>
<td>13.6</td>
<td>41,825</td>
</tr>
<tr>
<td>Central</td>
<td>70,262</td>
<td>88.2</td>
<td>7,250</td>
<td>9.1</td>
<td>79,646</td>
</tr>
<tr>
<td>Northeast</td>
<td>37,083</td>
<td>83.7</td>
<td>5,838</td>
<td>13.2</td>
<td>44,326</td>
</tr>
<tr>
<td>East</td>
<td>5,433</td>
<td>63.7</td>
<td>2,101</td>
<td>24.6</td>
<td>8,529</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>147,126</strong></td>
<td><strong>84.4</strong></td>
<td><strong>20,867</strong></td>
<td><strong>12.0</strong></td>
<td><strong>174,326</strong></td>
</tr>
</tbody>
</table>

Source: OCSB (2004).

Note: Number of total farms is calculated from the total number of farms in irrigated and rain fed areas.

5.2 Process of sugarcane growing

In Thailand, sugarcane is grown best in deep, well drained soils of medium fertility with loamy to loamy-sand soil textures, a pH range between 6.1-7.7 and an organic matter content of at least 1.5%. Clay-textured soils are unfavorable for sugarcane growth. Optimal temperatures are between 20 and 35 degrees Celsius. Under rain-fed conditions, good distribution of rainfall is required. The water requirement is 1.2-1.6 m/year.

However, sugarcane growers have faced many problems. First, farmers have been exploited by sugarcane cutters. Second, farmers cannot afford the high costs charged for sugarcane cutting. Third, farmers lost large quantities of sugarcane due to irregular cutting of sugarcane sticks at a height of about 6-8" from the ground level. This has affected farmer’s incomes. Fourth, farmers do not cut the sugarcane according to the standards required by the factory. Finally, rejection of sugarcane by factories due to the presence of waste in the sugarcane has caused another loss for farmers, since farmers have to bear the cost of cleaning.
Planting seasons:

Growers begin sugarcane planting during the end of the rainy season in order to maximize cane and sugar yields in sandy soils under rainfed condition, especially growers in the Northeast region of the country (Jintrawet et al 2000).

Sugarcane planting seasons in Thailand are generally two seasons. The first one is growing during the summer season and the other is sugarcane growing during the rainy season as it is shown in Table 5.4 and 5.5.

Table 5.4 Calendar of sugarcane planting and activities crossing the summer season

<table>
<thead>
<tr>
<th>Activities</th>
<th>Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Plowing first time with green manures (Soy bean and other legumes)</td>
<td>8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1 2</td>
</tr>
<tr>
<td>2. Plowing second time, ripper</td>
<td></td>
</tr>
<tr>
<td>3. Planting</td>
<td></td>
</tr>
<tr>
<td>4. Harrowing</td>
<td></td>
</tr>
<tr>
<td>5. Fertilizing</td>
<td></td>
</tr>
<tr>
<td>6. Herbicide and weeding</td>
<td></td>
</tr>
<tr>
<td>7. Soil cultivating</td>
<td></td>
</tr>
<tr>
<td>8. Harvesting (1st stubble)</td>
<td></td>
</tr>
</tbody>
</table>

Source: OCSB (2003).

Note: If the weather in that year is not suitable for sugarcane planting, the time period of sugarcane planting has to be adjusted.

1 = January, 2 = February, 3 = March, 4 = April, …., 12 = December
Table 5.5  Calendar of sugarcane planting and activities at the beginning of rainy season

<table>
<thead>
<tr>
<th>Activities</th>
<th>Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Breaking sugarcane ratoon and plowing</td>
<td>2</td>
</tr>
<tr>
<td>2. Plowing second time, ripper</td>
<td></td>
</tr>
<tr>
<td>3. Planting</td>
<td></td>
</tr>
<tr>
<td>4. Herbicide</td>
<td></td>
</tr>
<tr>
<td>5. Fertilizing</td>
<td></td>
</tr>
<tr>
<td>6. Herbicide and weeding</td>
<td></td>
</tr>
<tr>
<td>7. Soil cultivating</td>
<td></td>
</tr>
<tr>
<td>8. Harvesting (1st stubble)</td>
<td></td>
</tr>
</tbody>
</table>

Source: OCSB (2003).

In the Central region, planting takes place during February-April under irrigated conditions, and April-May under rain-fed conditions. In the North and Northeast, where cane is mainly grown under rain-fed conditions, the planting time is October-November. The remaining moisture in the soil at the end of the rainy season, together with fog and dew, helps in the germination of sugarcane and its survival through the dry season.

Land preparation:

Deep ploughing to at least 30 cm is recommended for conditions in Thailand, with subsoiling where hard pans have formed. In rain-fed conditions, a second ploughing should be practiced to further break soil down into a fine tilth, so that it can maintain its moisture for a longer time, this being especially so when sugarcane is planted towards the end of the rainy season.

Planting method:

Sugarcane is normally planted either as two- or three-budded sets in furrows, or as whole stalks cut into 30 cm lengths and covered with soil. Most sugarcane is planted manually, but machine planting is also practiced. Row and
plant spacing are 1.0-1.3 m x 0.5 m for manual planting. The row spacing is 1.4-1.6 m for machine planting. In the case of double row planting, there is 30 cm spacing between double rows and 1.3 m (1.00-1.40 m) between rows. It is recommended that a variety with high tiller should be planted at the wider row spacing and vice versa.

After planting, farmers should take care of their crops by watering and fertilizing gradually. Watering of plants during the first 11 months is essential. Every single set can produce up to seven crops (BIZ dimension, 2006).

**Pesticides:**

Pests and diseases insect pests: Major insect pests are shoot and stem borers, white fly and stem boring grubs.

a) Shoot and stem borers, include the early shoot borer (Chilo infuscatellus), white top borer (Scirpophaga exceptalis) and stem borer (Sesamia inferens). They can be controlled by: (1) using a resistant variety, for example Uthong 3; (2) using chemicals, for example carbofuran 3 % G (30-60 kg/ha) for irrigated conditions, cypermethrin 15% W/V EC (13 ml/20 l of water) and deltamethrin 3 % W/V EC (10 ml/20 l of water) for rain-fed conditions, and; (3) leaving waste to cover the field after harvest.

b) White fly (Aleuroloides barodensis) can be controlled by: (1) an application of fertilizer at the rate of 300 kg/ha, making the use of chemical controls unnecessary; (2) weed control, and; (3) in the case of a severe outbreak, spraying chemicals, such as dimethoate 40 % W/V EC (40 ml/20 l of water) or carbofuran 20 % W/V EC (50 ml/20 l of water).

c) Stem-boring grub (Dorysthenes bugueti) can be controlled by: (1) hand picking one or two times before planting; (2) crop rotation with cassava or pineapple, and; (3) an application of endosulfan and BPMC 4.5% G (30 kg/ha) in the furrows during planting.

**Fungicides:**

a) White leaf disease (phytoplasma) can be distinguished by a chlorosis of the leaves. It can be controlled by: (1) roguing of the diseased canes; (2) using disease-free cane sets that have been treated with hot water at 50 degree Celsius for 2 hour or dipped in tetracycline HCl (500 ppm) for 30 minutes before planting, and; (3) using tolerant cane varieties, for example, K 88-102.

b) Green grassy shoot disease (GGSD-phytoplasma) is typically recognized by profuse tillering with narrow green or pale green leaves. It can be controlled by: (1) roguing of the diseased canes, (2) using cane sets which have
been treated with hot water at 50 degree Celsius for 2 hour, and (3) using tolerant cane varieties for example Uthong 3.

c) Smut (Ustilago scitaminea): The symptom is easily recognized by the obvious whip-like sorus that arises from either the terminal meristem or lateral shoots of the infected stalk. It can be controlled by: (1) using the resistant varieties Uthong 1, Uthong 2, Uthong 3 and Uthong 4; (2) using disease-free planting materials; (3) roguing of the diseased shoots or stools, and; (4) in the case of disease-free multiplication plots, cane sets should be dipped in fungicides, for example propiconazol 10 % W/V EC (40 ml/20 l of water) or triadimefon 25 % WP (50g/20 l of water) for 30 minutes before planting.

d) Red rot wilt (Colletotrichum falcatum and Fusarium moniliforme): In the early growth stage, plants become yellow. After 5-6 months the stools die. The internal symptoms initially begin with a red rotting tissue, which can at times turn gray. The stem becomes hollow and dry with the cavity being occupied with the fungus mycelia and sometimes with fruiting bodies. The yield loss is up to 40-50 percent in plant cane and 100 percent in ratoon cane. The disease can be more serious in lowland plantations with poor drainage. It can be controlled by: (1) using the resistant varieties K 84-200, K 88-92, K 90-54, K 90-77 and Uthong 3; (2) roguing of the infected cane; (3) incorporating a crop rotation; (4) sun drying the soil for 3 months; (5) using disease-free cane sets, and; (6) using a fungicide such as benomyl 50 % WP (15g/20 l of water) or thiabendazol 90 % WP (15g/20 l of water) in which the planting sets are soaked.

Harvest:

Most farmers do their harvest without experimenting with modern techniques. Due to the lack of modernization and technology, sugarcane farmers suffer from high costs of production and low yields.

Cane harvesting in Thailand is done by hand and mechanization, which use labor intensively. More than 90 percent of cane harvesting is done manually, though only some farmers use special machinery. On average, one person can harvest a ton of cane in a day. The right time for harvesting sugarcane is when the crop is 12-14 months old. The sugarcane is cut as sticks from the ground level using a special type of knife. When the cane is harvested, it has a sugar content of about 12 percent. The roots are left in the ground as they will eventually sprout and grow to form the next crop. After cutting, the cane is stripped, topped and bound in bundles of 8-15 stalks for loading. Mechanical loaders have been introduced only recently, together with green cane harvesters. They have been effective in Central Thailand. Harvested cane, both green cut and burnt cut should be sent to the mill within 24-48 hours of cutting, since later transportation will result in sugar loss. The milling season starts from November and ends in March.
Transport:

The sugar cane transportation is carried out by grower, contractor and factory.

Irrigation:

According to table 3.1, 13.2% of the sugar cane farms in Thailand are irrigating their sugar cane fields, 86.8% of the cane farmers are growing cane under rainfed conditions. Irrigation is the most important in Central Thailand, where 27% of the cane farms are irrigating their cane. In all other regions, the share of irrigation cane farms of all cane growers is less than 3%.

Rotation:

The majority of crop rotation of sugarcane in Thailand is cassava or pineapple. The other crops are maize, rice and legume crops. However, the rotation of any type of crop is depending on the price of that crop and irrigation.

Number of ratoons:

In general, there are 3 ratoons of sugarcane planting in Thailand. Some sugarcane farms can plant sugarcane until 6 ratoons but the C.C.S. of sugarcane will decline.

5.3 Structure of the sugar industry

At present, there are 46 factories in Thailand situated in four parts of the country, i.e. Northern, Central, Eastern and Northeastern region. Table 5.6 shows the list of sugar factories in each region. There are 10 factories in Northern region, 18 factories in Central region, 5 factories in Eastern region, and 13 factories in Northeastern region.

The annual grinding season starts in November and ends in May depending on the quantity of sugar cane supplied to the mills. The largest factory is Kaset Thai with a capacity of 40,000 tons of cane crushed per day while the smallest one is Chiangmai with a capacity of 1,538 tons of cane crushed per day.
Table 5.6 Structure of the sugar industry in Thailand classified by province

<table>
<thead>
<tr>
<th>Northern region</th>
<th>Province</th>
<th>Number of Factories</th>
<th>Name of the Factories</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Chiangmai</td>
<td>1</td>
<td>Chiangmai</td>
</tr>
<tr>
<td></td>
<td>Lampang</td>
<td>1</td>
<td>Mae Wang Sugar Industry</td>
</tr>
<tr>
<td></td>
<td>Uttaradit</td>
<td>2</td>
<td>Uttaradit Sugar Industry</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Thai Identity</td>
</tr>
<tr>
<td></td>
<td>Kamphaengphet</td>
<td>2</td>
<td>Kampangpetch</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Nakornpetch</td>
</tr>
<tr>
<td></td>
<td>Nakhonsawan</td>
<td>2</td>
<td>Ruamphol Nakhonsawan</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Kaset Thai</td>
</tr>
<tr>
<td></td>
<td>Phitsanulok</td>
<td>1</td>
<td>Phitsanulok</td>
</tr>
<tr>
<td></td>
<td>Phetchabun</td>
<td>1</td>
<td>Thai Roong Ruang Industry</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>10</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Eastern region</th>
<th>Province</th>
<th>Number of Factory</th>
<th>Name of Factory</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Chonburi</td>
<td>3</td>
<td>Chonburi Sugar Industry</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>New Kwang Soon Lee</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Chonburi Sugar &amp; Trading</td>
</tr>
<tr>
<td></td>
<td>Rayong</td>
<td>1</td>
<td>Rayong</td>
</tr>
<tr>
<td></td>
<td>Sakaew</td>
<td>1</td>
<td>Eastern Sugar</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Total</strong></td>
<td><strong>5</strong></td>
</tr>
</tbody>
</table>

Source: OCSB (2004).
Table 5.6 Structure of the sugar industry in Thailand classified by province (continue)

<table>
<thead>
<tr>
<th>Central region</th>
<th>Province</th>
<th>Number of Factories</th>
<th>Name of the Factories</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prachuapkirikhan</td>
<td>1</td>
<td>Pranburi</td>
</tr>
<tr>
<td></td>
<td>Ratchaburi</td>
<td>2</td>
<td>Ratchaburi, Pong</td>
</tr>
<tr>
<td></td>
<td>Kanchanaburi</td>
<td>8</td>
<td>Mitr Kasetr, Thai Sugar Mill, New Krung Thai, Thai Multi-Sugar Industry, Tamaka, Prachuap Industry, Thai Sugar Industry, Wang Kanai</td>
</tr>
<tr>
<td></td>
<td>Saraburi</td>
<td>1</td>
<td>Saraburi</td>
</tr>
<tr>
<td></td>
<td>Lopburi</td>
<td>1</td>
<td>T.N. Sugar</td>
</tr>
<tr>
<td></td>
<td>Suphanburi</td>
<td>3</td>
<td>Suphanburi Sugar Industry, Mitr Phol, U-thong</td>
</tr>
<tr>
<td></td>
<td>Singburi</td>
<td>1</td>
<td>Singburi</td>
</tr>
<tr>
<td></td>
<td>Uthaithani</td>
<td>1</td>
<td>Kanchanaburi Industry</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>18</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Northeastern region</th>
<th>Province</th>
<th>Number of Factories</th>
<th>Name of the Factories</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Burirum</td>
<td>1</td>
<td>Burirum</td>
</tr>
<tr>
<td></td>
<td>Mukdahan</td>
<td>1</td>
<td>Saharuang</td>
</tr>
<tr>
<td></td>
<td>Udonthani</td>
<td>3</td>
<td>Rerm Udom, Kaset Phol, Kumpawapi</td>
</tr>
<tr>
<td></td>
<td>Khon Kaen</td>
<td>2</td>
<td>Khon Kaen, Mitr Phu Viang</td>
</tr>
<tr>
<td></td>
<td>Chaiyaphum</td>
<td>1</td>
<td>United Farmer &amp; Industry</td>
</tr>
<tr>
<td></td>
<td>Nakhonratchasima</td>
<td>3</td>
<td>Korach Industry, Angvian (Ratchasima), N.Y. Sugar</td>
</tr>
<tr>
<td></td>
<td>Kalasin</td>
<td>2</td>
<td>E - Saan Sugar Industry, Mitr Kalasin</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>13</td>
<td></td>
</tr>
</tbody>
</table>

Source: OCSB (2004).
5.4 Process of sugar production

There are two main steps in the sugar production process that are, the process of raw sugar production and the process of refined sugar production.

Step 1: Processing raw sugar from sugarcane (Figure 5.5)

Approximately 10% of sugar cane can be processed into commercial sugar. Sugar cane consists of 70% of water, 14% of fiber, 13.3% of saccharose (about 10 to 15% sucrose) and 2.7% of soluble impurities.

Harvesting:

Mature canes are gathered manually and mechanically. Hand cutting is the most common method, but some locations use mechanical harvesters. Canes are cut at ground level, the leaves are removed and the top is trimmed by cutting off the last mature joint. Cane is then tied in bundles and transported to a sugar factory. After cutting, cane deteriorates rapidly, so cane and beet cannot be stored for later processing without excessive deterioration of the sucrose content.

Cleaning and grinding:

Stalks are thoroughly washed and cut at the sugar mill. Rotating knives shred the cane into pieces, and multiple-sets of three-roller mills grind it. The crushed canes are transferred by conveyers from one mill to the next. During grinding, hot water is sprayed onto the sugarcane to dissolve any remaining hard sugar.
Juicing:

The shredded sugarcane travels on a conveyor belt through a series of heavy-duty rollers, which extract juice from the pulp. The pulp that remains, or “bagasse”, is dried and used as fuel. The raw juice moves on through the mill to be clarified.

Clarifying:

Carbon dioxide and lime juice are added to the liquid sugar and heated to around 95 degrees Celsius. As the carbon dioxide travels through the liquid, it forms calcium carbonate, which precipitates non-sugar debris (fats, gums and wax) from the juice. This precipitate, called "mud," is then separated from the juice by centrifugation. The juice is then filtered to remove any remaining impurities.

Evaporation:

The filtered juice is evaporated under a vacuum, concentrated at a low temperature, and the sugar crystallized in vacuum pans.

Crystallization:

Inside a sterilized vacuum pan, pulverized sugar is fed into the pan as the liquid evaporates, causing the formation of a thick mass of crystals. The crystals are spun-dry in a centrifuge, producing raw, inedible sugar.

A simplified flow diagram for a typical cane sugar production plant is shown in Figure 5.5 (Biz Dimension, 2006).
Figure 5.5 The Simplified Process Flow Diagram for Cane Sugar Production


Step 2: Refined sugar production (Figure 5.6)

A simplified process flow diagram from refined sugar production is shown in figure 5.6. The raw sugar obtained from cane requires refining to remove the molasses film and inorganic matter that have not been removed during the clarification process. The inorganic matter gives some color to the raw sugar that must be eliminated to obtain white sugar. The refined sugar process has several steps:
Affination:

The first step in sugar refining is affination. This is a mechanical process to remove the molasses film from raw sugar with warm, almost saturated, syrup. Crystals are separated from the syrup by centrifugal washing with hot water or a high purity solution of sugar. The syrup from the crystal washing, called affination syrup, is transferred to a remelt processing station and then to the clarification step. If the refinery is part of the raw sugar production facility, the cane sugar may be washed more heavily in previous steps and the affination step omitted.

Clarification:

The main purpose of clarification is to eliminate the inorganic impurities present in raw sugar. Chemical clarification, using phosphatation and carbonation, is the preferred method, though pressure filtration is also used. The next step is decolorization, to remove soluble impurities by adsorption by granular activate carbon and bone char, manufactured from degreased cattle bones.

Evaporation:

After clarification, the syrup must again be concentrated by multiple-effect evaporators and crystallized by vacuum pans. This is the same sequence used in the raw sugar process. Multiple-effect evaporators are used to raise the syrup to 70 Brix before final concentration to the crystallization point during the boiling process. In the multiple-effect process, the syrup moves through several inter-connected vacuum vessels. Every step (vessel) is called an effect.

Boiling step:

The syrup is further concentrated by boiling until sugar crystals are formed. Vacuum pans are used, requiring only small changes in operating conditions. A final mix of white sugar and residual molasses is obtained.
Crystallization step:

Refined sugar crystallizers, as used in raw sugar processing, cool the steam coming from the boilers to facilitate separation of white sugar from the molasses. Separation is carried out by centrifugation.

Drying and cooling:

The damp sugar from the centrifuges is then treated in a special piece of equipment usually consisting of 2 horizontal drums. In the first drum, the sugar is dried by hot air and in the second, known as the cooler, sugar crystals are dried in an ambient temperature. The sugar emerges from this stage with a water content of 0.03% and a temperature of 43-54 degree Celsius.

Screening:

The sugar from the dryer-cooler passes over vibrating screens, which separate out lumps that form when the sugar is sent to the bagging hopper.

Packaging:

The dried, cooled sugar is packed in 50 kilogram paper bags, stitched with cotton thread, and labeled as white, refined, sugar (Biz Dimension, 2006).
Figure 5.6 The Simplified Process Flow Diagram for Refined Sugar Production

6 PROFITABILITY OF SUGARCANE PRODUCTION IN THAILAND

This chapter presents the costs and returns associated with the production of sugarcane in selected sugarcane farms. The results are presented in eight sections. Section 6.1 of this chapter introduces the overview on research data. Section 6.2 focuses on patterns and costs of input use of sugarcane production for typical farms and reasons for their differences and section 6.3 examines patterns and total revenue of sugarcane production for typical farms and reasons for their differences. Section 6.4 then compares the profitability of sugarcane production between ratoons and regions. Section 6.5 presents break-even points of sugarcane production among different farms and regions. This section analyses break-even points of sugarcane production classified by ratoons, regions and size. Furthermore, break-even yield and break-even price are analyzed as well. Section 6.6 implements the comparison of gross margins of sugarcane production in different regions. Furthermore, section 6.7 demonstrates the comparison of costs and returns for sugarcane and competing crops. Finally, section 6.8 concludes the competitiveness of sugarcane production in Thailand.

6.1 Overview on research area

Before turning to the farm sample results, Table 6.1 gives an overview on sugarcane production and sugarcane yields in the research area to give an impression of their position in the domestic context.

The highest sugarcane production is found in Kanchanaburi province with an annual production of more than 4 million tons between 2003 and 2005, while the lowest sugarcane production is found in Prachuapkhirikhan province with a production of less than 700,000 tons per year.

Regarding sugarcane yields the highest yield was achieved in Udonthani province in 2003 with 11.11 tons per rai while the lowest yield was 6.04 ton per rai in Prachuapkhirikhan.
### Table 6.1 Development of sugarcane production and sugarcane yields in the main sugarcane producing provinces

<table>
<thead>
<tr>
<th>Region/Province</th>
<th>Sugarcane Production (Million tons)</th>
<th>Sugarcane Yield (tons per rai)</th>
<th>Sugarcane Yield (tons per hectare)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>North</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nakhon Sawan</td>
<td>4.3 4.2 3.5</td>
<td>10.1 9.3 7.6</td>
<td>63.2 58.0 47.6</td>
</tr>
<tr>
<td><strong>Northeast</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Udonthani</td>
<td>5.9 4.7 3.6</td>
<td>11.1 9.3 7.6</td>
<td>69.4 58.4 47.6</td>
</tr>
<tr>
<td>Khon Kaen</td>
<td>5.2 4.1 3.3</td>
<td>11.9 9.2 7.6</td>
<td>69.0 57.4 47.7</td>
</tr>
<tr>
<td><strong>Central</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kanchanaburi</td>
<td>7.7 5.5 4.1</td>
<td>10 8.9 6.7</td>
<td>62.2 55.4 41.8</td>
</tr>
<tr>
<td>Nakhon Pathom</td>
<td>1.1 1 0.7</td>
<td>10.3 9.4 7.2</td>
<td>64.6 58.5 45.1</td>
</tr>
<tr>
<td>Prachuapkhiri-</td>
<td>0.6 0.6 0.4</td>
<td>9.2 8.2 6</td>
<td>57.4 51.3 37.7</td>
</tr>
<tr>
<td>rikhan</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Source:** OCSB (2004).

Figure 6.1 indicates the size of sugarcane farms analyzed in the study area. Farms are shown on the x-axis and grouped by regions. The order within the regions is made according to sugarcane farm sizes. Each farm has a code that indicates the farm, the number of planted area and the region the farm is located, e.g. N1 means the first of interviewed farm in the North. The footnotes under each chart provide additional information on the region codes and specific information on the relevant chart.

Farm size data can be summarized as follows (Figure 6.1 and appendix table 6.1):

In the North (N1 to N7), there are a number of rather small farms with between 20 to 58 rai. According to the data collected, there are two medium size farms with 64 to 70 rai. Another large farm with 2,000 rai reflects the largest farm structure in the North.

In the Northeast (NE1 to NE10), there are five small farm with between 10 and 56 rai of sugar cane. Four farms with 200, 350, 600 and 1,000 rai represent large farms in the Northeast, and there is one medium size farm with 150 rai of sugar cane.

Farm sizes in the Central (C1 to C12) are small with between 5 to 44 rai of sugar cane. The smallest farms have farm area only 5 rai while medium size with between 70 to 100 rai and large farms of 224 to 930 rai.
Figure 6.1  Farm size of typical sugarcane farms analyzed in different regions

Note: Region code N-North, NE-Northeast, C-Central
Numbers indicate the sugarcane farm size

6.2 Patterns and costs of input use in sugarcane production

Cash costs require current cash outlays. Non cash costs can be deferred to later periods for payment. Because non cash costs can be deferred, often they are overlooked in the decision making process. This can be an error.

What are some cash and non cash cost? Depreciation is a non cash cost. That is, farmers prorate the investment’s cost over the life of the asset and do not make annual cash payments for the fixed cost. Interest on the investment can be cash or non cash. When an individual borrows money, the interest payment is a cash expense. If he or she uses owned capital, an opportunity cost of the capital is non cash cost. Property taxes are cash costs.

In general, repairs are cash costs. However, if a farmer uses his or heir own labor, this could be considered a non cash cost. Insurance can be cash or non cash cost. That is, if a farmer is self-insured, it is a non cash cost. If the farmer purchases commercial insurance, the premium would be paid as cash cost. In general, outlays for seed, fertilizer, lime, fuel, oil, lubricants, rented land or hired labor are cash costs.
It is important to remember that both cash and non cash costs must be considered when making farm financial decisions. In the short run and if a large proportion of the costs are non cash, less cash is needed to operate the business. However, in the long run, all cash and non cash costs must be covered (Lessley, Johnson and Hanson, 1991).

Depreciation is a noncash cost. That is, farmers prorate the investment's cost over the life of the asset and do not make annual cash payments for the fixed cost. If he or she uses owned capital, an opportunity cost of the capital is a noncash cost. Property taxes are cash costs. In general, repairs are cash costs. However, if a farmer uses his or her own labor, this could be considered a noncash cost. In general, outlays for seed, fertilizer, lime, fuel, oil, lubricants, rented land or hired labor are cash costs.

In addition to the previously indicated assumptions:

- All values are expressed in Thai Baht.
- All figures refer to the sugarcane farm.
- The farm data are collected in production year 2003/04.
- In this study, total cost is calculated from the summation of cash cost and non cash cost. Cash cost data is calculated as it shows in Table 6.2:

<table>
<thead>
<tr>
<th>Table 6.2</th>
<th>Details of calculation of total production costs of sugarcane farms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cash costs</strong></td>
<td><strong>Details</strong></td>
</tr>
<tr>
<td><strong>1. Variable Cost</strong></td>
<td><strong>1.1 Labour Cost</strong></td>
</tr>
<tr>
<td></td>
<td>Soil preparation, soil improvement, breed preparation, planting, fertilizing, chemical application, watering, weeding, harvesting,</td>
</tr>
<tr>
<td></td>
<td><strong>1.2 Factor Cost</strong></td>
</tr>
<tr>
<td></td>
<td>Breeding cost, fertilizer use, chemical use, watering cost, fuel and lubricant cost, management cost, maintenance cost,</td>
</tr>
<tr>
<td><strong>2. Fixed Cost</strong></td>
<td>Land use cost</td>
</tr>
<tr>
<td><strong>Non cash costs</strong></td>
<td>Depreciation and opportunity costs</td>
</tr>
<tr>
<td><strong>Total costs</strong></td>
<td>Cash costs + Non cash costs</td>
</tr>
</tbody>
</table>

Source: Lessley, Johnson and Hanson (1991) and own survey (2004).
Figure 6.2 shows the result of the cost comparison. Costs have been broken down in cash costs, depreciation and opportunity costs for production factors that are owned by the sugarcane farmer.

The results of the total cost comparison shown in Figure 6.2 can be summarized as follows. Production costs mostly consist of cash costs, while depreciation and opportunity costs only amount to less than 5%.

The total production costs of sugarcane farms for the first ratoon in the Northeast are lowest around 5,112 Baht per rai in the average compared to other regions. Low labor costs especially harvesting costs in the Northeast, of around 1,142 Baht per rai are the predominant reason for the lower cost structure. The harvesting cost in this region is low because the minimum wage rate in the Northeast is generally lower than other regions.

A farm in the North (farm N1), which has the largest farm size, has the lowest production cost. Sugarcane farm N1 has a significant total cost advantage relative to the other farms approximating the cost level of the farms around 3,245 Baht per rai.

The highest costs can be found in farm C4 and farm NE1. These farms have high cash costs because these farms have high labor and factor cost in some item. Besides, costs in the Central seem to be similar among the farms in the same region.

However, costs in the Central are higher compared to the investigated farms in the North and Northeast (above 5,000 Baht per rai) due to high labor costs which create a disadvantage for most farms in Central region. High labor costs in the Central region are because of the high living cost and minimum wage rate.
Figure 6.2 Total costs of sugarcane production for the first ratoon classified by cash costs, depreciation costs and opportunity costs in different regions in production year 2003/2004.


Note: Region code N-North, NE-Northeast, C-Central
Farm code N7 and C9 had no sugarcane production for the first ratoon in production year 2003/04.

Figure 6.3 shows the cost comparison between farms of the second ratoon. It is noticed that the second ratoon’s total costs are lower than the first ratoon’s with average costs of around 3,000 Baht per rai. Moreover, the average total costs of the second ratoon in the Northeast region farms are lowest.
Figure 6.3 **Total costs of sugarcane production for the second ratoon classified by cash costs, depreciation costs and opportunity costs in different regions in production year 2003/2004**


Note: Region code N-North, NE-Northeast, C-Central

Farm code NE3, NE7, NE10, C8 and C12 had no sugarcane production for the second ratoon in production year 2003/04.

Figure 6.4 presents the third ratoon sugarcane farms in different regions. It is interesting that the third ratoon farms are not found in the Northeast during the time period of data collection. This may be because the sugarcane price is fluctuated. The next important reason is Northeast region is a dry area and the source of water supply of sugarcane planting in this area mainly relies on rain. Therefore, sugarcane farmers in this region may switch to plant other competing crops, for instance, cassava, maize, bean and so on.

Meanwhile, there are some third raotoons in sugarcane farms in the North region. The average total cost is around 2,535 Baht per rai.

In general, the third ratoon is not widely planted. On the other hand, it is found that the third ratoon is planted in almost every farm in the Central region except in farm C2, C3, C8 and C12. This may be the consequence of the advantage that sugarcane farms in Central region gain from the irrigation system. However, the average total costs of the third ratoon in the Central region are high (around 3,570 Baht per rai).
Figure 6.4 Total costs of sugarcane production for the third ratoon classified by cash costs, depreciation costs and opportunity costs in different regions in production year 2003/2004


Note: Region code N-North, NE-Northeast, C-Central

Farm code N2, N5, N7, NE1-NE10, C2, C3, C8 and C12 had no sugarcane production for the third ratoon in production year 2003/04.

Table 6.3 reveals the summary of the average total cost of sugarcane production in different regions. The average total costs of first ratoon’s sugarcane production amount to 5,382 Baht per rai, followed by the average total costs in the second ratoon with 3,307 Baht per rai and in the third ratoon at 3,053 Baht per rai respectively. The detail of sugarcane production costs are in Appendix table 6.2-6.4.
Table 6.3  Summary of the average total cost of sugarcane production classified by regions

<table>
<thead>
<tr>
<th>Region</th>
<th>Unit</th>
<th>First ratoon</th>
<th>Second ratoon</th>
<th>Third ratoon</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>(Baht/rai)</td>
<td>5,314</td>
<td>3,326</td>
<td>2,535</td>
<td>3,725</td>
</tr>
<tr>
<td>Northeast</td>
<td>(Baht/rai)</td>
<td>5,112</td>
<td>3,148</td>
<td>-</td>
<td>4,130</td>
</tr>
<tr>
<td>Central</td>
<td>(Baht/rai)</td>
<td>5,719</td>
<td>3,447</td>
<td>3,570</td>
<td>4,245</td>
</tr>
<tr>
<td>Average</td>
<td>(Baht/rai)</td>
<td>5,382</td>
<td>3,307</td>
<td>3,053</td>
<td>3,914</td>
</tr>
</tbody>
</table>

Note: There was no sugarcane planting in the third ratoon in the Northeast region during the time of data collection. See appendix table 6.5.

6.3 Revenue of sugarcane production

The comparison of returns in sugarcane production between ratoons and regions is shown in Figure 6.4 to 6.6. The results can be summarized as follows:

- The observed sugarcane prices vary between farms and regions.
- For the first ratoon of sugarcane production, the price ranges between approximately 450 and 600 Baht per ton.
- For the second and third ratoon of sugarcane production, the price ranges between approximately 425 and 600 Baht per ton.

The sugarcane growing rotation in Thailand generally covers a three year period. The first year plantation will be harvested after not less than 11 months of growth. The second and the third (ratoon) crops take around 10-11 months for maturing.

The average yields and prices are shown in Table 6.4. On average, North, Northeastern, and Central farms obtained sugarcane yields of 10.26, 9.91 and 11.99 tons per rai respectively. The yield that Central farms obtained is somewhat higher than the national average yield, which is 10.8 tons per rai.

Interestingly, Northeastern and Central farms received a higher sugarcane price (506 and 505 Baht/ton), compared to the price that Northern growers received in the average (479.34 Baht/ton). This price difference may be due to
higher C.C.S. in the Northeast and Central regions. In this study, the prices have been obtained by averaging the price that each farm received.

### Table 6.4  Average sugar cane yield and price received of farm classified by regions in Thailand in the production year 2004/2005

<table>
<thead>
<tr>
<th>Unit</th>
<th>Region</th>
<th>Ratoon 1</th>
<th>Ratoon 2</th>
<th>Ratoon 3</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average yield</td>
<td>North</td>
<td>10.8</td>
<td>10.5</td>
<td>9.5</td>
<td>10.3</td>
</tr>
<tr>
<td></td>
<td>Northeast</td>
<td>10.4</td>
<td>9.4</td>
<td>-</td>
<td>9.9</td>
</tr>
<tr>
<td></td>
<td>Central</td>
<td>12.9</td>
<td>12.0</td>
<td>11.1</td>
<td>12.0</td>
</tr>
<tr>
<td></td>
<td><strong>Average</strong></td>
<td><strong>11.4</strong></td>
<td><strong>10.6</strong></td>
<td><strong>10.3</strong></td>
<td></td>
</tr>
<tr>
<td>Average price</td>
<td>North</td>
<td>473.5</td>
<td>490.4</td>
<td>474.2</td>
<td>479.3</td>
</tr>
<tr>
<td></td>
<td>Northeast</td>
<td>503.7</td>
<td>508.8</td>
<td>-</td>
<td>506.3</td>
</tr>
<tr>
<td></td>
<td>Central</td>
<td>498.9</td>
<td>504.7</td>
<td>512.6</td>
<td>505.4</td>
</tr>
<tr>
<td></td>
<td><strong>Average</strong></td>
<td><strong>492.0</strong></td>
<td><strong>501.3</strong></td>
<td><strong>493.4</strong></td>
<td></td>
</tr>
</tbody>
</table>


Note: See appendix table 6.6.

In order to calculate the return on sugarcane production, the preliminary and final sugarcane price has to be regarded.

Firstly, the preliminary sugarcane price is the price that sugarcane farmer get when they send sugarcane to the sugar factory.

Secondly, the final sugarcane price is the price that sugarcane farmers receive after the factory has calculated the C.C.S. value of sugarcane. It is an additional price which sugarcane farmer will receive, and then the OCSB announces the final C.C.S. value, which is different from region to region.

The preliminary sugarcane price is the price at a C.C.S. level of 10. The rate of change in sugarcane price (additional payment) was at 27.9 Baht per C.C.S. per metric tons in the production year 2003/04.

The total revenue in this study is calculated by multiplying the sugarcane farm price (preliminary price plus additional payment) with the sugarcane yield in tons per rai.

The data in Figure 6.5 depicts the total revenue of sugarcane production for the first ratoon. Sugarcane farmers in the Central region receive higher average total revenue than farmers in other region because sugarcane production
in the Central has the higher yield. Large farms such as farm N1, NE1 gain less total revenue.

**Figure 6.5** Total revenue of sugarcane production for the first ratoon classified by regions in production year 2003/2004


Note: Region code N-North, NE-Northeast, C-Central

Farm code N7 and C9 had no sugarcane production for the first ratoon in production year 2003/04.

As shown in Figure 6.6, the average total revenue which sugarcane farmers in the North region earn is around 5,118 Baht per rai. The highest revenue which sugarcane farmers in the North region received from second ratoon is 5,916 Baht per rai. In the Central region, the total revenue of sugarcane production varied from around 4,250 Baht per rai to maximum 8,763 Baht per rai.
Figure 6.6  Total revenue of sugarcane production for the second ratoon classified by regions in production year 2003/2004, in Baht per rai

![Graph showing total revenue of sugarcane production by region](image)


Note: Region code N-North, NE-Northeast, C-Central

Farm code NE3, NE7, NE10, C8 and C12 had no sugarcane production for the second ratoon in production year 2003/04.

The results of Figure 6.7 show that sugarcane farmers in the Central region still get high revenues from planting third sugarcane ratoon. However, the total revenue which farmers get varies a lot between the farms. This figure illustrates that no sugarcane farm in the Northeast region that planted sugar cane in the third ratoon.

Data in table 6.5 presents the comparison of total revenues of sugarcane farms in different ratoons and regions. On the average, sugarcane farmers benefit a lot from the first ratoon with revenue of 5,589 Baht per rai. However, the revenues decrease in the second and the third ratoon. This is probably as the reason for the farmers in the Northeast region not to plant third ratoons.
Figure 6.7  Total revenue of sugarcane production for the third ratoon classified by regions in production year 2003/2004

Note: Region code N-North, NE-Northeast, C-Central

Farm code N2, N5, N7, NE1-NE10, C2, C3, C8 and C12 had no sugarcane production for the third ratoon in production year 2003/04.

Table 6.5  Comparison of the total revenue of sugarcane production classified by regions

<table>
<thead>
<tr>
<th>Region</th>
<th>Unit</th>
<th>Total revenue of sugarcane production</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>First ratoon</td>
<td>Second ratoon</td>
</tr>
<tr>
<td>North</td>
<td>(Baht/rai)</td>
<td>5,091</td>
<td>5,118</td>
</tr>
<tr>
<td>Northeast</td>
<td>(Baht/rai)</td>
<td>5,236</td>
<td>4,804</td>
</tr>
<tr>
<td>Central</td>
<td>(Baht/rai)</td>
<td>6,441</td>
<td>6,100</td>
</tr>
<tr>
<td>Average</td>
<td>(Baht/rai)</td>
<td>5,589</td>
<td>5,341</td>
</tr>
</tbody>
</table>

Note: There was no sugarcane planting in the third ratoon in Northeast region during the time of data collection.
6.4 Economic profit of sugarcane production

To stay in business, a farm must generate a profit, at least in the long run. One of several important management tasks for farm managers, therefore, is assessing and improving farm profit. To calculate profit, farmers normally subtract the operating costs of seed, fertilizer, pesticides, fuel, interest, hired labor, others, from the year's income. Growing sugarcane also requires machinery and sometimes buildings, which add to the costs of the farm. When farmers subtract opportunity costs from the accounting profit, the result is commonly called economic profit.

\[
\text{Economic profit} = \text{Accounting profit} - \text{Opportunity cost}
\]
\[
= (\text{Total revenue} - \text{Total variable cost} - \text{Total fixed cost}) - \text{Opportunity cost}
\]

There are other costs associated with farmland, labor and management that ought to be considered. Farmers could be renting their land to someone else to generate income. Also, farmers should put a value on their personal labor and management since they could be earning income from an off-farm job on the side or if farmers were not managing a farm. These alternative values for land, labor and management are called “opportunity costs” or the income that farmers could be receiving by investing these resources in the next best alternative use (Johnson, Lessley and Hanson, 1998).

The profit of sugarcane farms in Table 6.6 shows that the average profit of sugarcane production in overall region in the second ratoon lead sugarcane farmers get the highest profit to more than 2,000 Baht per rai, while sugarcane production in the first and third ratoon give farmers less profit only 208 and 364 Baht per rai respectively. In sugarcane farm planting of the study area, it implies that sugarcane farmers have to wait until second ratoon that they will get the profit from their investment. So, some sugarcane planters may change to plant other competitive crops.
### Table 6.6 Profit of sugarcane farms classified by ratoon and regions

<table>
<thead>
<tr>
<th>Ratoon</th>
<th>Unit</th>
<th>Region</th>
<th>North</th>
<th>Northeast</th>
<th>Central</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total revenue</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st</td>
<td>(Baht/rai)</td>
<td>5,091</td>
<td>5,236</td>
<td>6,441</td>
<td>5,589</td>
<td></td>
</tr>
<tr>
<td>2nd</td>
<td>(Baht/rai)</td>
<td>5,118</td>
<td>4,804</td>
<td>6,100</td>
<td>5,341</td>
<td></td>
</tr>
<tr>
<td>3rd</td>
<td>(Baht/rai)</td>
<td>4,478</td>
<td>-</td>
<td>5,771</td>
<td>5,125</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>(Baht/rai)</td>
<td>4,896</td>
<td>5,020</td>
<td>6,104</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total cost</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st</td>
<td>(Baht/rai)</td>
<td>5,314</td>
<td>5,112</td>
<td>5,719</td>
<td>5,382</td>
<td></td>
</tr>
<tr>
<td>(Cash cost+ Non cash cost)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2nd</td>
<td>(Baht/rai)</td>
<td>3,326</td>
<td>3,148</td>
<td>3,447</td>
<td>3,307</td>
<td></td>
</tr>
<tr>
<td>3rd</td>
<td>(Baht/rai)</td>
<td>2,535</td>
<td>-</td>
<td>3,570</td>
<td>3,053</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>(Baht/rai)</td>
<td>3,725</td>
<td>4,130</td>
<td>4,245</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economic profit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st</td>
<td>(Baht/rai)</td>
<td>-</td>
<td>223</td>
<td>124</td>
<td>722</td>
<td>208</td>
</tr>
<tr>
<td>2nd</td>
<td>(Baht/rai)</td>
<td>1,792</td>
<td>1,656</td>
<td>2,653</td>
<td>2,034</td>
<td></td>
</tr>
<tr>
<td>3rd</td>
<td>(Baht/rai)</td>
<td>1,943</td>
<td>-</td>
<td>2,201</td>
<td>2,072</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>(Baht/rai)</td>
<td>1,171</td>
<td>890</td>
<td>1,859</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opportunity cost</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st</td>
<td>(Baht/rai)</td>
<td>243</td>
<td>237</td>
<td>314</td>
<td>270</td>
<td></td>
</tr>
<tr>
<td>2nd</td>
<td>(Baht/rai)</td>
<td>150</td>
<td>120</td>
<td>149</td>
<td>141</td>
<td></td>
</tr>
<tr>
<td>3rd</td>
<td>(Baht/rai)</td>
<td>131</td>
<td>-</td>
<td>155</td>
<td>147</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>(Baht/rai)</td>
<td>175</td>
<td>119</td>
<td>206</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Note:  
- There was no sugarcane planting in the third ratoon in the Northeast region during the time of data collection. See appendix table 6.8.

- Total cost = Cash cost + Non cash cost

- Total cost = Cash cost + (Depreciation + Opportunity costs)

- Total cost is already included opportunity cost.

Considering the average profit of sugarcane production over all ratoons, it is found that the Central region has the highest average profit of around 1,859 Baht per rai. The North and Northeast region gain the lower profits with 1,171 and 890 Baht per rai respectively.

Even though sugar cane growers in the Central regions have slightly higher production costs than farmers in other regions, Central region farmers earned a much higher revenues (6,104 Baht/rai) than Northeastern and Northern farmers (5,020 and 4,896 Baht/rai).

According to the analysis of economic profit, it is found that the growers in the first ratoon gain the lowest profit with 208 Baht/rai.
6.5 Break-even points of sugarcane production

6.5.1 Definition of break-even yield and break-even price

The break-even point analysis in this study is divided into break-even yield and price. *Break-even yield* and *break-even price* are classified by each ratoon and region, which is presented in this section.

The break-even analysis is a useful tool to study the relationship between fixed costs, variable costs and returns. A break-even point defines when an investment will generate a positive return and can be determined graphically or with simple calculation the break-even yield analysis computes the volume of production at a given price necessary to cover all costs.

Break-even price analysis computes the price necessary at a given level of production to cover all costs. To explain how break-even analysis works, it is necessary to define the cost items.

The main advantage of break-even analysis is that it points out the relationship between cost, production volume and returns. It can be extended to show how changes in fixed cost - variable cost relationships, in commodity prices, or in revenues, will affect profit levels and break-even points. Limitations of break-even analysis include:

- It is best suited to the analysis of one product at a time;
- It may be difficult to classify a cost as all variable or all fixed; and
- There may be a tendency to continue to use a break-even analysis after the cost and income functions have changed.

Break-even analysis is most useful when used with partial budgeting or capital budgeting techniques. The major benefit to using break-even analysis is that it indicates the lowest amount of business activity necessary to prevent losses (BIZ 2002).

**Break-even yield**

The Break-Even Yield allows one to know the minimum yield for the farm to be profitable. The formula for computing the break-even yield is:

\[
\text{Break-even yield} = \frac{\text{Total cost}}{\text{Output price}}
\]

This is the yield necessary to cover all costs at a given output price (Markus 2006). For example, total costs (fixed costs + variable costs) = $157.50/hectare, output price = $80/ton. Therefore, Break-Even Yield is =157.5/80 = 1.97 tons/ha (FAO 2006).
In this study, the calculation of total cost is as follows (Table 6.2):

\[
\text{Total cost} = \text{Cash cost} \ (\text{variable cost} + \text{fixed cost}) + \\
\text{Non cash cost} \ (\text{depreciation} + \text{opportunity cost})
\]

**Break-even price**

The analysis of break-even price in section 6.5.4 applies the formula as follows:

Break-even price is the output price needed to just cover all costs at a given output level, and can be found from the equation (Markus 2006).

\[
\text{Break-even price} = \frac{\text{Total cost}}{\text{Expected yield}}
\]

For example, the break-even price would be $157.5 divided by 2.5 tons is equal to $63. Notice that the break-even price is the same as the cost of production (FAO 2006).

### 6.5.2 Break-even yield and break-even price of sugarcane production

This section is the analysis of break-even yield and break-even price of sugarcane production. The calculation of break-even yield is done by dividing total costs by the average sugarcane price. To calculate the break-even price, total costs are divided by the average sugarcane yield (Table 6.7).
Table 6.7  Break-even yield and break-even price of sugarcane production classified by ratoons and regions

<table>
<thead>
<tr>
<th></th>
<th>Unit (Baht/rai)</th>
<th>Ratoon</th>
<th>North</th>
<th>Northeast</th>
<th>Central</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average total cost</td>
<td></td>
<td>1st</td>
<td>5,314</td>
<td>5,112</td>
<td>5,719</td>
<td>5,382</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2nd</td>
<td>3,326</td>
<td>3,148</td>
<td>3,447</td>
<td>3,307</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3rd</td>
<td>2,535</td>
<td>-</td>
<td>3,570</td>
<td>3,053</td>
</tr>
<tr>
<td>Average price*</td>
<td>(Baht/ton)</td>
<td>1st</td>
<td></td>
<td></td>
<td></td>
<td>495</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2nd</td>
<td></td>
<td></td>
<td></td>
<td>501.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3rd</td>
<td></td>
<td></td>
<td></td>
<td>499.8</td>
</tr>
<tr>
<td>Average yield*</td>
<td>(Tons/rai)</td>
<td>1st</td>
<td></td>
<td></td>
<td></td>
<td>11.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2nd</td>
<td></td>
<td></td>
<td></td>
<td>10.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3rd</td>
<td></td>
<td></td>
<td></td>
<td>11.3</td>
</tr>
<tr>
<td>Average break-even yield (TC/price)</td>
<td>(Tons/rai)</td>
<td>1st</td>
<td>10.7</td>
<td>10.3</td>
<td>11.6</td>
<td>10.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2nd</td>
<td>6.6</td>
<td>6.3</td>
<td>6.9</td>
<td>6.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3rd</td>
<td>5.1</td>
<td>0.0</td>
<td>7.1</td>
<td>6.1</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td></td>
<td>7.5</td>
<td>8.3</td>
<td>8.5</td>
<td></td>
</tr>
<tr>
<td>Average break-even price (TC/yield)</td>
<td>(Baht/ton)</td>
<td>1st</td>
<td>463.2</td>
<td>445.6</td>
<td>498.5</td>
<td>469.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2nd</td>
<td>308.1</td>
<td>291.6</td>
<td>319.3</td>
<td>306.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3rd</td>
<td>223.6</td>
<td>0</td>
<td>315.0</td>
<td>269.3</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td></td>
<td>331.6</td>
<td>368.6</td>
<td>377.6</td>
<td></td>
</tr>
</tbody>
</table>


Note:  * The calculation of break-even yield and price use the average value of price and yield in all farms in order to make the equivalent of the calculation. Thus, the price and yield in each region are not show in the table in order to avoid the confusion. See appendix table 6.9.

From table 6.7, the average break-even yield for the first ratoon of sugarcane production is 10.9 Tons/rai, which is calculated from average total costs of 5,382 Baht/rai divided by the average price of 495 Baht/ton. Break-even yield means that the sugarcane farmer must receive this yield to cover the costs related to sugarcane production. Generally, the lowest break-even yield is related to the highest competitiveness. The average break-even yield for the third ratoon of sugarcane production is 6.1 Tons/rai. This means that sugarcane farmers would reach the break-even point for covering all costs if they produce at least 6.1 Tons/rai. According to break-even yields by region, sugarcane farmers in the North have lower break-even yields than farmers in the other regions (7.5 Tons/rai). Thus, sugarcane farmers in the North have the high of competitiveness in sugarcane production.
Considering the break-even price analysis, the break-even price is the price a producer must receive minimum for a product in order to cover the entire costs associated with the production of the product (Hofstrand 2005). The average break-even prices of the different ratoons are different. Sugarcane in the third ratoon has an average break-even price of 269.3 Baht/ton (5.4 Euro/ton), while sugarcane in the first ratoon has an average break-even price of 469.1 Baht/ton. Therefore, the continuing production until the third ratoon is a good choice because sugarcane farmers start making profit from a sugarcane price of minimum 269.3 Baht/ton. Comparing break-even prices by region, there is no big difference. The break-even prices range from 331.6 to 377.6 Baht/ton.

6.6 Comparison of gross margins of sugarcane production

The gross margin is a tool that can be used to evaluate the performance of farm enterprises as well as the efficiency of alternative decisions that affect farm activities.

A positive gross margin is a contribution towards paying the fixed costs. Therefore, maximising gross margin is equivalent to maximising profit (or minimising losses) because the fixed costs are constant.

The gross margin reflects the relationship between price, volume, and cost. Therefore, the gross margin can be influenced by changes in:

- The selling price
- The cost of production
- Any variations in the organisation of the farm

Gross Margin calculation requires:

- Estimation of output (yields and expected prices) for each enterprise.
- The calculation of total variable costs, which requires identifying each variable input needed, the amount required, and its purchase price.

However, the indication given by this gross margin is rather limited for planning, budgeting or even reviewing enterprises.

To detect possible deficiencies in the farm system, there is a need to analyze the gross margin for the individual enterprises on the farm.

If the gross margin is calculated for planning purposes, the problems detected could help farmers analyze alternative solutions. When calculated with the objective of analyzing the enterprise or farm performance, the gross margin
is an excellent source of information for planning purposes for the next agricultural season (FAO, 2005).

The calculation of gross margin is derived from the difference between total revenue and total variable costs. Total variable costs are calculated from the summation of total labor costs and total factor cost.

The calculation result from Table 6.8 shows that sugarcane farmers in the Central region have the highest gross margin, whereas gross margin of sugarcane farmers in the North seem to be similar to the Northeast.

Comparing the average gross margin by ratoon, it is apparent that the average gross margin in the first ratoon is three times lower than other ratoons. The average gross margin of the second and third ratoon equals to 2,608 and 2,618 Bath per rai, respectively.

According to the average total variable costs, there is no big difference between regions (3,305.7 to 3,566.3 Baht per rai). However, the average total revenue between regions is significantly different (between 4,895.7 and 6,104 Baht per rai). This is the cause of the difference in the average gross margin between regions.

Considering the average total variable costs in different ratoons, it is shown that sugarcane in the first ratoon has higher total variable cost (4,820.3 Baht per rai) than in the other ratoons, because the first ratoon of sugarcane production has very high total labor costs and total factor costs, while the second and third ratoon of sugarcane production have only half of the labor and factor costs compared to the first ratoon.

Sugarcane farms in the Central region attain the highest average gross margin in the production year 2003/04 (2,537.7 Baht/rai) while sugarcane farmers in the North and Northeast region only earn an average gross margin of 1,590 and 1,492.5 Baht/rai respectively.
### Table 6.8 Revenues, variable costs and gross margins of sugarcane production classified by ratoon and region in the production year 2003/2004

<table>
<thead>
<tr>
<th>Ratoon</th>
<th>Unit</th>
<th>Region</th>
<th>North</th>
<th>Northeast</th>
<th>Central</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>(Baht/rai)</td>
<td>5,091.0</td>
<td>5,236.0</td>
<td>6,441.0</td>
<td>5,589.3</td>
<td></td>
</tr>
<tr>
<td>2nd</td>
<td>(Baht/rai)</td>
<td>5,118.0</td>
<td>4,804.0</td>
<td>6,100.0</td>
<td>5,340.7</td>
<td></td>
</tr>
<tr>
<td>3rd</td>
<td>(Baht/rai)</td>
<td>4,478.0</td>
<td>-</td>
<td>5,771.0</td>
<td>5,125.0</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>(Baht/rai)</td>
<td><strong>4,895.7</strong></td>
<td><strong>5,020.0</strong></td>
<td><strong>6,104.0</strong></td>
<td><strong>4,782.1</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ratoon</th>
<th>Unit</th>
<th>Region</th>
<th>North</th>
<th>Northeast</th>
<th>Central</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>(Baht/rai)</td>
<td>4,823.0</td>
<td>4,405.0</td>
<td>5,233.0</td>
<td>4,820.3</td>
<td></td>
</tr>
<tr>
<td>2nd</td>
<td>(Baht/rai)</td>
<td>2,751.0</td>
<td>2,650.0</td>
<td>2,797.0</td>
<td>2,732.7</td>
<td></td>
</tr>
<tr>
<td>3rd</td>
<td>(Baht/rai)</td>
<td>2,343.0</td>
<td>-</td>
<td>2,669.0</td>
<td>2,506.0</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>(Baht/rai)</td>
<td><strong>3,305.7</strong></td>
<td><strong>3,527.5</strong></td>
<td><strong>3,566.3</strong></td>
<td><strong>3,466.5</strong></td>
<td></td>
</tr>
</tbody>
</table>

- Average total labor costs

<table>
<thead>
<tr>
<th>Ratoon</th>
<th>Unit</th>
<th>Region</th>
<th>North</th>
<th>Northeast</th>
<th>Central</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>(Baht/rai)</td>
<td>2,616.0</td>
<td>2,490.0</td>
<td>3,299.0</td>
<td>2,801.7</td>
<td></td>
</tr>
<tr>
<td>2nd</td>
<td>(Baht/rai)</td>
<td>1,661.0</td>
<td>1,576.0</td>
<td>1,671.0</td>
<td>1,636.0</td>
<td></td>
</tr>
<tr>
<td>3rd</td>
<td>(Baht/rai)</td>
<td>1,387.0</td>
<td>-</td>
<td>1,602.0</td>
<td>1,494.5</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>(Baht/rai)</td>
<td><strong>1,888.0</strong></td>
<td><strong>2,033.0</strong></td>
<td><strong>2,190.7</strong></td>
<td><strong>2,037.2</strong></td>
<td></td>
</tr>
</tbody>
</table>

- Average total factor costs

<table>
<thead>
<tr>
<th>Ratoon</th>
<th>Unit</th>
<th>Region</th>
<th>North</th>
<th>Northeast</th>
<th>Central</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>(Baht/rai)</td>
<td>2,207.0</td>
<td>1,915.0</td>
<td>1,934.0</td>
<td>2,018.7</td>
<td></td>
</tr>
<tr>
<td>2nd</td>
<td>(Baht/rai)</td>
<td>1,090.0</td>
<td>1,074.0</td>
<td>1,126.0</td>
<td>1,096.7</td>
<td></td>
</tr>
<tr>
<td>3rd</td>
<td>(Baht/rai)</td>
<td>956.0</td>
<td>-</td>
<td>1,067.0</td>
<td>1,011.5</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>(Baht/rai)</td>
<td><strong>1,417.7</strong></td>
<td><strong>1,494.5</strong></td>
<td><strong>1,375.7</strong></td>
<td><strong>1,429.3</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Average gross margin

<table>
<thead>
<tr>
<th>Ratoon</th>
<th>Unit</th>
<th>Region</th>
<th>North</th>
<th>Northeast</th>
<th>Central</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>(Baht/rai)</td>
<td>268.0</td>
<td>831.0</td>
<td>1,208.0</td>
<td>769.0</td>
<td></td>
</tr>
<tr>
<td>2nd</td>
<td>(Baht/rai)</td>
<td>2,367.0</td>
<td>2,154.0</td>
<td>3,303.0</td>
<td>2,608.0</td>
<td></td>
</tr>
<tr>
<td>3rd</td>
<td>(Baht/rai)</td>
<td>2,135.0</td>
<td>-</td>
<td>3,102.0</td>
<td>2,618.5</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>(Baht/rai)</td>
<td><strong>1,590.0</strong></td>
<td><strong>1,492.5</strong></td>
<td><strong>2,537.7</strong></td>
<td><strong>1,873.4</strong></td>
<td></td>
</tr>
</tbody>
</table>


Note: See appendix table 6.10.
6.7 Comparison of sugarcane production and competing crops

6.7.1 Production of competing crops

There are four main crops competing with sugarcane production. These are rice, pineapple, cassava and maize. In the following these crops will be analysed concerning their planting, harvesting, production and cropping area.

Rice

Rice fields in Central Thailand can manage at least two harvests a year. In contrast to rice fields in the Northeast, that basically only gets one harvest per year (Grimson 2006).

The rice-planting season in Thailand usually starts in May. Around this time, showers signal the approaching end of the dry season and farmers once more prepare for rice planting as one annual cycle ends and another begins. Since most Thai farmers have to wait for seasonal rain to plant their annual rice crop, they are at times faced with difficulties from drought, so there might not be enough rainfall for crop growing.

By late November or early December, rice in the North and the Central region of the country is ready to be harvested. Farmers go into the fields with sickles to harvest their crop. The cut rice is spread on the fields to dry for several days before being bundled into sheaves and taken to the family compound where it is threshed.

Except in the South, where monsoons arrive later in the year, harvesting usually ends in January or February. Then the farm family turns its energies to activities neglected during the harvest. Buildings, tools, and fences are repaired and secondary crops are either planted or harvested (PRD 2005).

Pineapple

The period between planting and harvesting is usually two to two and half years (BIZ Dimension 2006).

The pineapple was a very minor crop in Thailand until 1966 when the first large cannery was built. Others followed. Since then processing and exporting have risen rapidly. In 1977-78 many farmers switched from sugarcane to pineapple. Of the annual production of 1.5 million tons, 0.125 is canned as fruit or juice (Morton 1987).
Thailand is the world's largest producer of pineapple. In 1999 was the year in which there had been a significant increase in terms of both areas of planting and production yield in Thailand. The total production was right around 2.353 million tons, which is almost 32% higher than 1998's 1.787 million tons production according to the Food and Agricultural Organization of the United Nations (FAO) statistics. This could partly be a result of the high price of pineapple during 1997 to 1998 which inspired the farmers to expand and optimize their growing area.

Unsurprisingly, the price has come down dramatically as a consequence. In November 1999, the price almost bottomed out to 1.28 Baht/kg, which was 19% less than its previous month and 76% less than the same period last year. Regarding the production capacity, the canned pineapple manufacturers are able to switch their production line to other kinds of fruits, so the actual production capacity in 1999 were at 70%, up from 50% in 1998 when the overall pineapple production decreased due to the El Nino phenomena.

Even though competition has risen due to Antidumping Law posted by the US government and Generalized System of Preference (GSP) cut by EU, lower pineapple price helped Thai pineapple industry to be still able to maintain its competitiveness.

During the first three quarters of 1999, Thailand had exported about 333,754 metric tons of canned pineapple (9,109 million Baht), up from the previous year (1998) by 109%. Total export volume in 1999 increased substantially from 1998 due to large supply of pineapples.

General Problems for Thai pineapple industry are:
- Low production yield - average 3.7 to 4.1 tons/rai.
- Insufficient number of workers in agricultural field.
- High fluctuation of product price which greatly affects agricultural businesses.
- Declining area of plantation.
- Climatic fluctuation resulting in delay of raw material supplies.
- Lack of Thai brand existence.
- Termination of GSP privilege for Thai pineapple by EU resulting in higher duties for exporters.
- High import duties for packaging materials and unreliability of local materials.
- Complication and slow process of obtaining tax rebates.
- Lack of financial assistance to ensure continuous and regular supply of raw materials, and high interest rates for loans.
- Inadequate technology in many areas such as production, farming and product development, as well as slow expansion of the growing areas to support the rapidly increasing demand (BIZ Dimension, 2006).
Cassava

Cassava is one of the major crops for the Thai economy. It is second only to rice and rubber. Not only is cassava a food crop, it is also used as animal feeds and raw materials for a number of industries. Cassava planting season in Thailand usually starts in May to June. After 8 to 12 months, cassava is ready to be harvested.

Cassava is annual output ranges between 18-20 million tons, 80 percent of which are exported to the overseas markets, earning about 21,400 million Baht per year for the past 5 years.

Thailand ranks third of the world’s cassava producers, the first and second ranks belong to Nigeria and Brazil. However, for the exports of cassava, Thailand has come to the first rank for over 30 years, capturing about 88 percent of market shares during the years 1996-2000. European Union, the world’s biggest importer of cassava, cuts down cassava imports as they have shifted to their home-grown crops for a replacement. Average productivity of Thai cassava stands at 2.4 tons per rai (during 1997-1999) compared with the world’s average rate, 1.6 tons per rai (BOT, 2000).

Maize

Maize is one of five major crops in Thailand. In addition to rice, cassava, sugarcane, and rubber, maize occupies a major portion (about 33%) of Thai upland farmlands. In 1984-85, 12.4 million rai (nearly 2 million ha) were planted to maize, ranking second only to rice (59 million rai or 9.5 million ha). In 1984, Thailand exported 3.0-3.7 million tons of maize and earned nearly 10,000 million Baht (US$ 400 million), but thereafter maize area began to decline and occupied only 7.3 million rai (nearly 1.2 million ha) by 2002-03, with a production of around 4.5 million tons.

In most of the Lower Northeast, Upper Northeast, and some parts of the Lower North, farmers planted only one crop of maize per year during the early rainy season from April to June.

Maize planted areas in this study have one cropping season. It is planted in rainy seasons between April and July. Sugarcane farmers in this study plant maize as their minor or secondary crops. It can be grown one time a year, but it provides a lower income than sugarcane (Ekasingh et al 2004).
6.7.2 Profitability of sugarcane and its competing crops

Figure 6.8 shows the total variable costs and total fixed costs of sugarcane and competing crops. It shows that rice farmers had the lowest total variable cost and maize had the second lowest total variable costs. While the highest total variable costs were caused by pineapple and sugarcane production in first and second ratoon respectively.

**Figure 6.8  Comparison of total variable costs and total fixed costs of sugarcane and competing crops**

![Comparison of total variable costs and total fixed costs of sugarcane and competing crops](chart)


Figure 6.9 shows the income situation for the period for all crops examined. The best ranking position for total revenue of all crops over the period of analysis were pineapple, sugarcane first and second ratoon respectively, and the lowest ranking was maize, with total revenue of rice, cassava and maize quite similar.
The total revenue and profit was highest for pineapple, followed by sugarcane first and second ratoon, rice, cassava and maize. However, sugarcane first and second ratoon had the lowest production costs (economic cost), followed by cassava, rice and maize had the fourth lowest production costs. Table 6.9 outlines the profitability of sugarcane production and its competing crop in comparison.

The cost comparisons noted above are an important part of the analysis of competitiveness. Cost comparisons, particularly total cost comparisons, can be misleading, however, when it is only looked at in isolation. Farm income of sugarcane production does not appear so attractive for planting sugarcane first and second ratoon. Comparing the farm income and profit with other competing crops, it is found that the profit of sugarcane is lower than that of rice production almost three times because normally rice can be grown two or three times a year in Thailand depending on the irrigation area.
Table 6.9 Profitability of sugarcane production and its competing crops in the production year 2003/04

<table>
<thead>
<tr>
<th>Items</th>
<th>Sugarcane Ratoon</th>
<th>Average sugarcane</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st</td>
<td>2nd</td>
</tr>
<tr>
<td>Total revenue (Bath/rai)</td>
<td>5,589</td>
<td>5,341</td>
</tr>
<tr>
<td>Gross margin (Baht/rai)</td>
<td>769</td>
<td>2,608</td>
</tr>
<tr>
<td>Accounting profit (Baht/rai)</td>
<td>473</td>
<td>2,173</td>
</tr>
<tr>
<td>Economic profit (Baht/rai)</td>
<td>208</td>
<td>2,034</td>
</tr>
<tr>
<td><strong>Ranking of economic profit</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Items</th>
<th>Competing Crops (per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rice (2 times/year)</td>
</tr>
<tr>
<td>Total revenue (Bath/rai)</td>
<td>7,300</td>
</tr>
<tr>
<td>Gross margin (Baht/rai)</td>
<td>4,750</td>
</tr>
<tr>
<td>Accounting profit (Baht/rai)</td>
<td>3,942</td>
</tr>
<tr>
<td>Economic profit (Baht/rai)</td>
<td>2,946</td>
</tr>
<tr>
<td><strong>Ranking of economic profit</strong></td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Items</th>
<th>Competing Crops* (per one crop)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rice</td>
</tr>
<tr>
<td>Total revenue (Bath/rai)</td>
<td>3,650</td>
</tr>
<tr>
<td>Gross margin (Baht/rai)</td>
<td>2,375</td>
</tr>
<tr>
<td>Accounting profit (Baht/rai)</td>
<td>1,971</td>
</tr>
<tr>
<td>Economic profit (Baht/rai)</td>
<td>1,473</td>
</tr>
</tbody>
</table>


Note: Rice can be planted two times a year, pineapple can be harvested in the second year, cassava and maize can be planted once a year.

*Competing crops (per one crop) : figures are related to one harvest.
6.8 Conclusions for the competitiveness of sugarcane production in Thailand

Sugarcane in Thailand is widely planted in Central, North, Northeast and East. The highest sugarcane production was in Kanchanaburi province with a production of more than 4 million tons between 2003 and 2005, while the lowest sugarcane production was in Prachuap Khirikhan province with a production below 700,000 tons per year. The result of the analysis can be concluded as follows:

The costs of sugarcane production for the first ratoon are very high. The cost decline in the second and third ratoon. However, there is a small number of farms running the third ratoon because the third ratoon has low yield of sugarcane production. These are the farms in Central and North. In the average, farms in the Central have the highest cost of production in all ratoons, while farms in the Northeast have the lowest cost in the first and second ratoon.

The total revenue of sugarcane production in the second ratoon of the farm does not decrease much from the first ratoon but it declines sharply in the third ratoon. The result is unpopular investment in the third ratoon. The sugarcane farms in Central region gain the highest returns compared to other regions in every ratoon.

The profitability of sugarcane production of farms in all regions reaches a peak in the second ratoon. The Central region sugarcane farms gain the highest profit. The next are the farms from the North and Northeast respectively.

Break-even point analysis divided into break-even yield and break-even price analysis. Break-even yield and price of sugarcane production by ratoon of each farm are different from ratoon. The average break-even point of farms in the third ratoon is lower than other ratoons. It means that the third ratoon farms have low fixed cost. Break-even yield and price of sugarcane production in the Central is higher than in other regions.

Gross margin of sugarcane production of sugarcane farms in the Central region are much higher than in other regions.

The comparison of sugarcane and the competing crops shows that there are four main competing crops of sugarcane, which are, rice, pineapple, cassava, and maize. Pineapple planning has the highest total cost but it also has the highest revenue.

In conclusion, sugarcane production in Thailand is still the key crop for sugarcane farmers because the secondary crops can not be perfectly substitutes. Rice can be planted in low land and it needs plenty of water. Pineapple can be planted only in some provinces. Cassava planting may cause the problem of soil and earn less gross margin. Maize price has low incentive for sugarcane farmers.
to switch to plant it. Therefore, sugarcane production expects to be important and can compete with other crops.
7 COMPETITIVENESS OF SUGAR FACTORIES IN THAILAND

The empirical results of the investigation of sugar factories in Thailand are presented in this chapter. This chapter is organized as follows. Section 7.1 explains characteristics of the investigated sugar factories. Section 7.2 analyses sugarcane supply. Section 7.3 describes sugar sales of the sugar industry. Section 7.4 explains the sugarcane transport from field to factory. Section 7.5 analyses sugar production of the sugar industry. Section 7.6 demonstrates the analysis of extraction rate of sugar per ton of sugarcane. Section 7.7 illustrates the analysis sugar production cost. Section 7.8 presents the profitability analysis of sugar production. Section 7.9 shows the competitiveness of investigated sugar factories. Section 7.10 gives the information about the environmental regulation of the sugar industry. Section 7.11 shows problems and obstructions of the sugar industry. Section 7.12 suggests ways to solve problems and shows future strategies of the sugar industry. The chapter ends with section 7.13, which is the summary of the main findings.

7.1 Characteristics of the investigated sugar factories

Before going into detail of the sugar factory analysis, the understanding of background information of the factories is important. The answers of five sugar factories could be integrated in the evaluation (Table 7.1). They represent the sugar factories in the research area, the North, Central and Northeast region. Factory A is a large size factory. Factory B, C, D and E are small size factories. Factory A has an average crushing capacity of more than 23,812 tons/day. All the other factories have an average crushing capacity of less than 12,095 tons/day.

<table>
<thead>
<tr>
<th>Factory</th>
<th>Factory</th>
<th>Factory</th>
<th>Factory</th>
<th>Factory</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
</tr>
<tr>
<td>Size</td>
<td>Large</td>
<td>Small</td>
<td>Small</td>
<td>Small</td>
</tr>
<tr>
<td>Region</td>
<td>North</td>
<td>North</td>
<td>Central</td>
<td>Central</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average crushing capacity (Ton/day)</td>
<td>&gt; 23,812</td>
<td>&lt; 12,095</td>
<td>&lt; 12,095</td>
<td>&lt; 12,095</td>
</tr>
<tr>
<td>Number of sugarcane supplier</td>
<td>4,678</td>
<td>925</td>
<td>473</td>
<td>276</td>
</tr>
<tr>
<td>Owner: Bank: Other enterprises:</td>
<td>6: 1: 80: 13</td>
<td>0: 0: 57: 43</td>
<td>100: 0: 0: 0</td>
<td>100: 0: 0: 0</td>
</tr>
</tbody>
</table>

Source: Own survey.
7.2 Analysis of sugarcane supply

Factory A has the highest number of sugarcane suppliers. Each factory has different shareholders and administration. In Factory C and D is the entire share in the hand of one owner.

The analysis of sugarcane supply in table 7.2 presents that sugar factories have their sugarcane suppliers. Most of the suppliers are the small size farms with less than 59 rai of sugarcane. Only factory C mainly keeps contract with medium and large size sugarcane suppliers.

Table 7.2 Structure of sugarcane suppliers

<table>
<thead>
<tr>
<th>Size of sugarcane supplier</th>
<th>Sugar Factory</th>
<th>Number of supplier</th>
<th>Total</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Factory A (Large)</td>
<td>Factory B (Small)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 59 rai</td>
<td>3,416.00</td>
<td>573.00</td>
<td>4,310.00</td>
<td>67.84</td>
</tr>
<tr>
<td>Percent</td>
<td>73.02</td>
<td>61.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60-199 rai</td>
<td>1,043.00</td>
<td>279.00</td>
<td>1,681.00</td>
<td>26.46</td>
</tr>
<tr>
<td>Percent</td>
<td>22.30</td>
<td>30.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 199 rai</td>
<td>219.00</td>
<td>73.00</td>
<td>362.00</td>
<td>5.70</td>
</tr>
<tr>
<td>Percent</td>
<td>4.68</td>
<td>7.89</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total number of</td>
<td>4,678.00</td>
<td>925.00</td>
<td>6,353.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Source: Own calculation.

Note: Information about sugarcane supplier of factory E is not available.

Table 7.3 illustrates the share of total sugarcane which a factory received from different sizes of sugarcane farmers. Although most of the factories have many contracts with small size sugarcane farms, but most of the sugarcane supply comes from large size sugarcane farms. For example, factory A deals with 3,416 farmers (73%) that are small farms, but the share of total sugarcane received from large sugarcane farms accounts for 52.31%.
Table 7.3  Share of total sugarcane received (%)

<table>
<thead>
<tr>
<th>Size of sugarcane area suppliers</th>
<th>Share of sugarcane received (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Factory A</td>
</tr>
<tr>
<td>(&lt; 59 rai)</td>
<td>20.80</td>
</tr>
<tr>
<td>(60-199 rai)</td>
<td>26.89</td>
</tr>
<tr>
<td>(&gt; 110 rai)</td>
<td>52.31</td>
</tr>
</tbody>
</table>

Source: Own calculation.

Note: Information about sugarcane supplier of factory E is not available.

Therefore, the difference in the number of sugarcane suppliers in each factory is significantly important for the competitiveness because if a factory can find large sugarcane suppliers who can supply a large amount of sugarcane, the factory do not need to deal with many sugarcane suppliers. It will short cut the complicated process of sugarcane delivering and it will save factory costs in management. Furthermore, if sugarcane suppliers have to wait for a long time, on the queue to deliver sugarcane, for example more than 5 days, it will affect the C.C.S. and quality of sugarcane and then affect the costs of the factory.

7.3 Sugar sales

The share of sales in monetary value of a factory in different channels reflects the distribution of its sugar production and the competitiveness of the factory in stimulating the sales. If a factory can sell its sugar production very fast through different channels, the factory will has high competitiveness. Table 7.4 demonstrates the distribution of sugar of the analyzed factories through different market channels by different shares. It depends on the strategies of each factory. For example, factory C chooses the strategy to distribute its sugar through wholesale network by up to 95%, the rest is distributed through consumer market. Factory B distributes sugar through wholesale network by more than 76%, the rest is distributed through domestic sales and sugar exporters. Factory A concentrates on sales to sugar exporters. The rest is distributed through wholesale network and companies in branch.
Table 7.4  The share of total sales in monetary value (%)

<table>
<thead>
<tr>
<th>Distribution of sugar production through:</th>
<th>Factory A</th>
<th>Factory B</th>
<th>Factory C</th>
<th>Factory D</th>
<th>Factory E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wholesale network</td>
<td>11-25%</td>
<td>&gt; 76%</td>
<td>95%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sugar Export trader</td>
<td>51-75%</td>
<td>&lt; 10%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Company in branch</td>
<td>11-25%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Domestic sales to food and beverage industry</td>
<td>-</td>
<td>11-25%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Domestic sales to Consumer market</td>
<td>-</td>
<td>-</td>
<td>5%</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: Own survey.
Note: Information is not available for factory D and E.

7.4  Sugarcane transport from field to factory

The average distance of sugarcane transport from field to sugar factory is another important factor, which affects the competitiveness of the sugar industry. For instance, if the distance of sugarcane transport is big, the costs of transportation and management will be high.

In Thailand, sugarcane growers respond to sugarcane transportation costs by delivering sugarcane to the nearby factory. The process of sugarcane transportation is different from region to region. In the Northeast, there are the centers to collect sugarcane. The percentage of loss will be high because sugarcane is transported to the center and then to the factory. However, in the Central regions, factories receive sugarcane from sugarcane growers directly at the factory gate. Most of factories use the queuing system to organize the sugarcane transporting trucks on the way to the factory gate. Many times sugarcane transporting trucks have to wait overnight to deliver sugarcane to a factory.

As it can be seen from table 7.5, sugar factories have two sources of sugarcane. The first source is sugarcane purchasing from sugarcane farmers. The second source is sugarcane supply from own factory farms.

As a result, it was found that the average distance of transporting sugarcane from factory-own farms is shorter than from other farms. The average
distance of transporting sugarcane from factory-own farms to the factory is about 31.88 km. These factories probably have their own farms around the factory. Factories will buy more sugarcane, when the quantity of sugarcane from factory-own farms is not sufficient.

However, the average distance of sugarcane, which is purchased from sugarcane farmers is around 53.33 km. Comparing factories, factory C has no advantage from factory-own sugarcane farms, as they are located very far from the factory. In the point of view of sugarcane transporters, they normally will decide to deliver sugarcane to the closest factory in order to save costs of transportation and time. Therefore, in this case factories have to offer a bonus to increase the incentive for sugarcane farmer to supply sugarcane to a special factory.

**Table 7.5  Average distance of sugarcane transport from field to the sugar factory in the year 2003/04**

<table>
<thead>
<tr>
<th>Source of sugarcane</th>
<th>Distance (Km.)</th>
<th>Average (Km.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Factory A</td>
<td>Factory B</td>
</tr>
<tr>
<td>Private sugarcane farmers</td>
<td>50.00</td>
<td>40.00</td>
</tr>
<tr>
<td>Factory's sugarcane farms</td>
<td>17.50</td>
<td>30.00</td>
</tr>
</tbody>
</table>

Source: Own survey.

Note: Information of factory E is not available.

**7.5 Analysis of sugar production of the sugar industry**

The examination of sugar production per unit of land (kg of sugar/rai) provides information with respect to technology and production efficiency of the sugar industry. If one factory can produce more sugar per rai than any other factory, the first one will have an advantage in competitiveness.

The analysis of sugar production presents a comparison of production between sugar factories as it is shown in table 7.6. Especially, factory C possesses an advantage with respect to kilogram of total sugar production per rai in production year 2002/03 and 2003/04. Comparisons among each type of sugar production show that in both years, factory C has a high production in plantation white sugar compared to other factories.
Table 7.6  Productivity indicators in Thailand's sugar industry

<table>
<thead>
<tr>
<th></th>
<th>White sugar</th>
<th>Raw sugar</th>
<th>Total Sugar Production</th>
<th>Sugarcane Area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Plantation</td>
<td>Refined</td>
<td>Total</td>
<td></td>
</tr>
<tr>
<td></td>
<td>white sugar</td>
<td>sugar</td>
<td>(Kg/rai)</td>
<td>(Kg/rai)</td>
</tr>
<tr>
<td></td>
<td>(Kg/rai)</td>
<td>(Kg/rai)</td>
<td>(Kg/rai)</td>
<td>(Rai)</td>
</tr>
<tr>
<td><strong>Production Year 2002/03</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factory A</td>
<td>222</td>
<td>55</td>
<td>277</td>
<td>589</td>
</tr>
<tr>
<td>Factory B</td>
<td>242</td>
<td>277</td>
<td>519</td>
<td>352</td>
</tr>
<tr>
<td>Factory C</td>
<td>990</td>
<td>-</td>
<td>990</td>
<td>262</td>
</tr>
<tr>
<td>Factory D</td>
<td>338</td>
<td>208</td>
<td>546</td>
<td>133</td>
</tr>
<tr>
<td>Factory E</td>
<td>n/a</td>
<td>-</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Average</td>
<td>448</td>
<td>180</td>
<td>583</td>
<td>334</td>
</tr>
<tr>
<td><strong>Production Year 2003/04</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factory A</td>
<td>191</td>
<td>100</td>
<td>291</td>
<td>638</td>
</tr>
<tr>
<td>Factory B</td>
<td>383</td>
<td>8</td>
<td>390</td>
<td>647</td>
</tr>
<tr>
<td>Factory C</td>
<td>743</td>
<td>-</td>
<td>743</td>
<td>470</td>
</tr>
<tr>
<td>Factory D</td>
<td>395</td>
<td>114</td>
<td>509</td>
<td>277</td>
</tr>
<tr>
<td>Factory E</td>
<td>319</td>
<td>-</td>
<td>319</td>
<td>824</td>
</tr>
<tr>
<td>Average</td>
<td>406</td>
<td>74</td>
<td>451</td>
<td>571</td>
</tr>
</tbody>
</table>

Source: OCSB (2002/03) and own calculation.

Note:  
- Total sugar production is the sum of plantation white sugar, raw sugar and refined sugar.
- Total sugarcane input is the sum of own factory sugarcane and purchased sugarcane.

For the production of refined sugar, factory B was the leader in refined sugar production in 2002/03 and factory D had the highest production in 2003/04. Viewing raw sugar production per rai, factory A leads the raw sugar producers in 2002/03, followed by factory B, factory C and then factory D. However, factory E becomes the leader in raw sugar production in 2003/04.

The average value of total sugar production is about 917 kg/rai in 2002/03 and it climbed up to average 1,022 kg/rai in 2003/04. In 2002/03, plantation white sugar was produced with the highest amount at the average 448 kg/rai but in 2003/04 mostly raw sugar was produced 571 kg/rai in the average.
7.6 Analysis of the extraction rate of sugar

The average sugar extraction rate (ETR) in Thailand amounts to 100 kg of sugar per ton of sugarcane. Therefore, if there is sugarcane supply of 10 tons of one rai, the factory can produce 1,000 kg of sugar.

With respect to extraction rates (ETR), measured in kg of sugar per ton of sugarcane, the average ETR of the interview factories are about average 96.68 kg/ton of sugarcane in the production year 2002/03 and increases to 106.72 kg/ton of sugarcane in the production year 2003/04 (Figure 7.1).

Figure 7.1 shows that the ETR of all factories in 2003/04 is higher than in 2004/05. The quantity of rain will likely enlarge the average extraction rate of sugarcane for sugar to average 106.72 kg/ton of sugarcane, compared to average 96.68 kg/ton of sugarcane in the previous year.

Factory E has the highest ETR of account for 114 kg/ton of sugarcane in the production year 2003/04. This means that factory E produce 114 kg of sugar from 1 ton of sugarcane input.

Figure 7.1  Sugar extraction rates of the investigated sugar factories (kg per ton of sugarcane)

Source: Own calculation.
Note: Extraction rate=Total quantity of sugar*100/Total quantity of sugarcane

Figure 7.2 and 7.3 depict the ETR of sugar per ton of sugarcane in production year 2002/03 and 2003/04. The figures show the efficiency of sugar extraction of the investigated sugar factories as well as their production program concerning the type of sugar which is produced. In production year 2002/03, the
ETR of sugar production of the studied factories is 96.68 kg/ton of sugarcane in the average. Each factory has different rates and types of sugar production, which depend on the strategies of each factory. From figure 7.2, factory C has ETR of plantation white sugar higher than other factory account for 70.73 kg/ton of sugarcane, while factory E choose to produce a lot on raw sugar with ETR of raw sugar account for 78.16 kg/ton of sugarcane.

According to figure 7.3, the average ETR of entire factory is higher to 106.72 kg/ton of sugarcane in the production year 2003/04. This implies that the efficiency of sugar production is higher because of several factors. For example, if CCS of sugarcane increased or the environmental factor which suitable for sugarcane planting, this will lead the ETR high in that year. In 2003/04, ETR of each factory was higher than 2002/03 with more that 100 kg/ton of sugarcane.

Moreover, factory C and E still produce plantation white sugar oriented, while factory E produce raw sugar oriented. The last interesting point is almost the entire sugar factory has lowest ETR of refined sugar, especially factory C and E did not produce refined sugar in both years. Similarly, factory B had high ETR of refined sugar in 2002/03 with 30.84 kg/ton of sugarcane and its ETR of refined sugar decreased in 2003/04.

**Figure 7.2 Extraction rate of sugar (kg of sugar per ton of sugarcane) in production year 2002/03**

Source: Own calculation.
The extraction rate is influenced by the quality of sugarcane provided by sugarcane farmers and factory-own sugarcane farms. A high extraction rate of sugar reduces costs of inputs (the sugarcane). Besides, the extraction rate of sugar depends on the weather conditions. If sugarcane production had been affected by drought in that production year, it would have dampened the extraction rate of sugarcane for sugar, leading to a sharp reduction in sugar production.

**7.7 Analysis of sugar production costs**

Another important factor that influences competitiveness is cost of production. This indicator provides information that incorporates cost of inputs, technology, and other factors that influence the factory’s cost structure. The analysis of sugar production in table 7.7 and 7.8 provide several comparisons among factories, concerning costs of production.
Table 7.7  Variable costs of sugar production in Thailand

<table>
<thead>
<tr>
<th></th>
<th>Cost of sugar production (Baht/kg)</th>
<th>Cost of sugar production (Baht/rai)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Production Year 2002/03</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factory A</td>
<td>9.98</td>
<td>8,646.84</td>
</tr>
<tr>
<td>Factory B</td>
<td>7.01</td>
<td>6,105.96</td>
</tr>
<tr>
<td>Factory C</td>
<td>11.14</td>
<td>13,948.26</td>
</tr>
<tr>
<td>Factory D</td>
<td>9.51</td>
<td>6,452.82</td>
</tr>
<tr>
<td>Factory E</td>
<td>n.a</td>
<td>n.a</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>9.41</strong></td>
<td><strong>8,788.47</strong></td>
</tr>
<tr>
<td><strong>Production Year 2003/04</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factory A</td>
<td>10.13</td>
<td>9,419.75</td>
</tr>
<tr>
<td>Factory B</td>
<td>7.25</td>
<td>7,520.91</td>
</tr>
<tr>
<td>Factory C</td>
<td>7.64</td>
<td>9,262.34</td>
</tr>
<tr>
<td>Factory D</td>
<td>6.41</td>
<td>5,042.81</td>
</tr>
<tr>
<td>Factory E</td>
<td>9.93</td>
<td>11,355.78</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>8.27</strong></td>
<td><strong>8,520.32</strong></td>
</tr>
</tbody>
</table>

Source: Own calculation.

Note: Production cost consists of processing cost and labor cost. Processing cost consists of raw material cost, transportation cost, energy cost, process material cost and factory overheads cost.

The analysis of sugar production costs is shown in table 7.7. The examined costs of production are measured in Baht/kg and Baht/rai. The average cost of sugar production was 9.41 Baht/kg in 2002/03 and it declined to 8.27 Baht/kg in 2003/04. In 2002/03, factory B had the lowest cost of sugar production of 7.01 Baht/kg, while factory D had the lowest cost of sugar production in 2003/04 (6.41 Baht/kg).

The analysis of sugar production costs per rai shows that the average costs of sugar production amounted to 8,788.47 Baht/rai in 2002/03 and declined to around 8,520.32 Baht/rai in 2003/04.

Table 7.8 breaks down the costs of sugar production in fixed costs and variable costs. Fixed costs are costs for land, building, construction and machines. The items of variable costs are raw material, transportation, energy, process material, labor and factory overhead cost.
In the average the variable production costs amount to 8.27 Baht/kg. This means that the production of 1 kg of sugar will have average processing costs of 7.88 Baht/kg and labor costs of 0.39 Baht/kg. Comparing the costs of each factory, it is found that factory D has the lowest variable costs. Moreover, the analysis of processing costs shows that factory A has the highest costs. Concerning labor costs, factory B has the highest costs.

The analysis of fixed cost shows that the share of fixed costs is very high. It is the costs that factories invest by huge amounts of capital from the beginning of the business. The cost of machinery is the major item. According to the data, the costs of sugar production of 1 kg will have fixed costs of 7.80 Baht/kg in the average. Factory A has the highest fixed cost and depreciation. To sum up, the fixed cost of each factory is different, depending on the value of machines.

### Table 7.8 Total costs of sugar production in Thailand in the year 2003

<table>
<thead>
<tr>
<th></th>
<th>Factory A</th>
<th>Factory B</th>
<th>Factory C</th>
<th>Factory D</th>
<th>Factory E</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>North</td>
<td>North</td>
<td>Central</td>
<td>Central</td>
<td>Northeast</td>
<td></td>
</tr>
<tr>
<td><strong>A. PRODUCTION COST (Baht/kg)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Processing cost (Baht/kg)</td>
<td>9.98</td>
<td>6.74</td>
<td>7.16</td>
<td>6.06</td>
<td>9.46</td>
<td><strong>7.88</strong></td>
</tr>
<tr>
<td>2. Labor cost (Baht/kg)</td>
<td>0.15</td>
<td>0.51</td>
<td>0.48</td>
<td>0.35</td>
<td>0.47</td>
<td><strong>0.39</strong></td>
</tr>
<tr>
<td><strong>Total variable costs</strong> (Baht/kg)</td>
<td>10.13</td>
<td>7.25</td>
<td>7.64</td>
<td>6.41</td>
<td>9.93</td>
<td><strong>8.27</strong></td>
</tr>
</tbody>
</table>


Note: - Item A consists of processing cost and labor cost. Processing cost consists of raw material cost, transportation cost, energy cost, process material cost and factory overheads cost.
Table 7.8 Total costs of sugar production in Thailand in the year 2003 (continue)

<table>
<thead>
<tr>
<th></th>
<th>Factory A</th>
<th>Factory B</th>
<th>Factory C</th>
<th>Factory D</th>
<th>Factory E</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>North</td>
<td>North</td>
<td>Central</td>
<td>Central</td>
<td>Northeast</td>
<td></td>
</tr>
<tr>
<td>B. NET LAND, BUILDING AND MACHINE COST</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Land cost (Baht/kg)</td>
<td>0.44</td>
<td>0.56</td>
<td>0.86</td>
<td>1.05</td>
<td>0.38</td>
<td>0.66</td>
</tr>
<tr>
<td>2. Building and construction cost (Baht/kg)</td>
<td>1.49</td>
<td>2.91</td>
<td>0.49</td>
<td>3.13</td>
<td>0.99</td>
<td>1.80</td>
</tr>
<tr>
<td>3. Machinery and instrument cost (Baht/kg)</td>
<td>19.88</td>
<td>0.79</td>
<td>2.29</td>
<td>12.74</td>
<td>3.28</td>
<td>7.80</td>
</tr>
<tr>
<td>4. Other capital cost (Baht/kg)</td>
<td>0.78</td>
<td>7.59</td>
<td>0.37</td>
<td>0.83</td>
<td>1.37</td>
<td>2.19</td>
</tr>
<tr>
<td>Total fixed cost (Baht/kg)</td>
<td>22.58</td>
<td>11.85</td>
<td>4.00</td>
<td>17.76</td>
<td>6.02</td>
<td>12.44</td>
</tr>
<tr>
<td>5. Depreciation cost of capital (Baht/kg)</td>
<td>11.90</td>
<td>1.61</td>
<td>0.79</td>
<td>8.82</td>
<td>0.06</td>
<td>4.64</td>
</tr>
<tr>
<td>Net land, building and machine cost (Baht/kg)</td>
<td>10.68</td>
<td>10.24</td>
<td>3.22</td>
<td>8.93</td>
<td>5.96</td>
<td>7.81</td>
</tr>
</tbody>
</table>


Note: - Item B consists of land cost, building and construction cost, machinery and instrument cost, other capital cost and depreciation cost.

### 7.8 Profitability analysis of sugar production

The analysis of the previous section on the production costs of sugar linked this section on the profitability analysis. The ability of exiting factories to gain profitability indicates that they will possess a competitive advantage. However, an increase in the profitability of a sugar factory may indicate an increase in competitiveness, but it may not indicate whether this is a result of decreased cost or improved product quality. Therefore, the increase in profitability of a factory may be a result of the increasing the sale revenue or of other related factors.
According to table 7.9, producer profit shows that sugar producers made an average profit of 0.21 Baht/kg in the production year 2002/03. Then, the average profit of sugar production increased to 0.45 Baht/kg in production year 2003/04. It is interesting to note that factory C, which is a small factory, shows negative profits in both years. It may be due to high interests the factory has to pay. Factory B gains the highest profit in sugar production in 2002/03 (0.62 Baht/kg) and factory E achieve the highest profit in 2003/04 (1.40 Baht/kg).

### Table 7.9 Profit of sugar production in Thailand

<table>
<thead>
<tr>
<th>Production Year 2002/03</th>
<th>Profit of sugar production (Baht/kg)</th>
<th>Profit of sugar production (Baht/rai)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factory A</td>
<td>0.26</td>
<td>223.42</td>
</tr>
<tr>
<td>Factory B</td>
<td>0.62</td>
<td>539.97</td>
</tr>
<tr>
<td>Factory C</td>
<td>-0.59</td>
<td>-737.82</td>
</tr>
<tr>
<td>Factory D</td>
<td>0.57</td>
<td>386.58</td>
</tr>
<tr>
<td>Factory E</td>
<td>n.a</td>
<td>n.a</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>0.21</strong></td>
<td><strong>103.04</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Production Year 2003/04</th>
<th>Profit of sugar production (Baht/kg)</th>
<th>Profit of sugar production (Baht/rai)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factory A</td>
<td>0.27</td>
<td>246.72</td>
</tr>
<tr>
<td>Factory B</td>
<td>0.19</td>
<td>193.89</td>
</tr>
<tr>
<td>Factory C</td>
<td>-0.23</td>
<td>-275.38</td>
</tr>
<tr>
<td>Factory D</td>
<td>0.61</td>
<td>476.35</td>
</tr>
<tr>
<td>Factory E</td>
<td>1.40</td>
<td>1,599.34</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>0.45</strong></td>
<td><strong>448.19</strong></td>
</tr>
</tbody>
</table>

Source: Own calculation.

Concerning the profit per rai of sugarcane production, it is found that the average profit per rai amounted to 103 Baht/rai in 2003/04 and increased to 448 Baht/rai in 2003/04. This may be due to the decrease of average production cost.

### 7.9 Competitiveness of the investigated sugar factories

To evaluate the competitiveness of the investigated sugar factories, various indicators are implemented.
The ranking score of the competitiveness of sugar industry in this section has the purpose to rank the competitiveness and position of factories by each indicator. In addition, it is the summary the competitiveness indicator which has already analyzed in the detail of each indicator in the previous section. The analyzing of the score come from the average of total quantity of sugar production, ETR of sugar per ton of sugarcane, cost of sugar production and profit of sugar production in the production year 2002/03 and 2003/04. The method to give the score is under the condition that if the factory did the best or be the leader in each indicator, the score will be higher. For example, the factory that has the more quantity of sugar production in kg/rai, the factory will be the leader and then it will get the highest score. If the factory has the higher ETR of sugar per ton of sugarcane, the factory will earn higher competitiveness. The lower cost of sugar production, the better the competitiveness of factory. The last point is that if the factory gains the higher the profit of sugar production, the higher the competitiveness the factory is.

### Table 7.10 Ranking of the investigated sugar factories according to their competitiveness

<table>
<thead>
<tr>
<th>Indicators of competitiveness</th>
<th>Factory A</th>
<th>Factory B</th>
<th>Factory C</th>
<th>Factory D</th>
<th>Factory E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cane productivity (kg of sugar production/rai)</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>ETR of sugar (kg of sugar per ton of sugarcane)</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Cost of sugar production (Baht/kg)</td>
<td>1</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Cost of sugar production (Baht/rai)</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Profit of sugar production (Baht/kg)</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Profit of sugar production (Baht/rai)</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Revenue per output (Baht/kg of sugar)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total score</td>
<td>14</td>
<td>21</td>
<td>12</td>
<td>20</td>
<td>23</td>
</tr>
<tr>
<td>Ranking position</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: Own calculation.

Note: -The data is the average of competitiveness indicators in the production year 2002/03 and 2003/04.
- The distance indicator is not included in this ranking analysis because there is no data available.
The ranking of the competitiveness of sampling sugar industry has been addressed in table 7.10. The score in table was ranked from the highest (score 5) to the lowest (score 1). In the case that the factory has the highest performance in that competitiveness indicator, the highest score the factory received. The ranking score in this section is different from the previous section because the previous section is the analysis separately in each factory and each production year but in this section is the average value of each competitiveness indicators in both years. Therefore, it will show the entire picture of competitiveness of sugar industry.

The result from the table shows the evidence that factory C had the advantage in total quantity of sugar production. Meanwhile, factory E had the highest advantage in ETR of sugar per ton of sugar cane and gained the highest profit of sugar production. However, factory B was the highest ability to produce sugar with the lowest cost per kg and factory D was the leader in reduce cost of sugar production in Baht per rai. In the summary, when summary the score of overall factor of competitiveness, it found that factory E got the highest score. Therefore, factory E has been ranked to be the highest competitiveness factory, following with factory B, factory D, factory A, and factory C respectively.

Therefore, the result of this analysis provides information that can be utilized in the development of sugar factory strategies competitiveness plans. For instance, the cost of sugar production in Baht per kg indicates that individual firms could strategically position themselves by directing resources toward enhancing the cost-competitiveness of their sugar factories.

7.10 Environmental regulations of the sugar industry

Sugar industry of Thailand has the standard of waste water (effluents) treatment, air emissions, and residual treatment.

7.10.1 Waste water treatment

There are the regulations and laws concerning waste water quality of factory following the standard announced by Ministry of Industry of Thailand. The limitation of the quality control is PH at 5.5 to 9, TDS less than 3,000 mg/liter, BOD less than 20 mg/liter, COD less than 400 mg/liter and suspension solid not more than 150 mg/liter.

The process of waste water treatment is different between factories. Some factories use the system of “stabilization pond” which divided pond for water treatment such as “Anaerobic pond”, “Facultative pond”, oxidation pond, pond
to leave the waste water for the cleaning waste water process until reach the standard level of waste water treatment. Some factories use pond to adjust PH of waste water to neutralize and use oil trapping pond to trap the oil and recycle lubricant. Some of waste water will evaporated by natural. Some factories use the waste water treatment pond and add the air by using “Airrator” in order to let waste water settled on the base ground and then threat them later.

The procedure for the waste water treatment of some factories use the “over flow” way, which is the way to release the waste water flow as natural, without machinery or tools for waste water treatment. Normally, the factory will have the outsider inspector laboratory come to measure the value of waste water and controlling system. Therefore, the cost of environment control will effect on the cost and competitiveness of factory because the factory must to pay to the laboratory to measure the waste water treatment, which is very expensive. The cost of water calibration of factory A is around 12,160 Baht per month, which is not including the cost of waste water treatment. In the case of factory B, the way for waste water treatment is very high. The factory has to buy the large land, invest for the waste water pond, use the process of pumping water and draining water, which is labor intensive. The system of Thailand is different from European country which use machine to eliminate waste water. For factory D, the cost of waste water treatment is around 50,000 Baht per year. For factory E, the costs include the costs of inspection and analysis, waste water treatment, electricity. It is around 203,572 Baht per year.

7.10.2 Air emissions control

For the air emissions control, there is the law of the National Environment control in year 1992 and the announcement of Ministry of Industry to set the standard of the air quality controlled the factory emission to the atmosphere and the quantities of the emission of chemical, dust and waste form factory to the public air. There is the standard of dust, carbon monoxide, carbon dioxide and nitrogen controlled. The quantity of dust released (TSP) is limited at 400 mg/m3. SO2 released is limited at 1,300 mg/m3. NO2 is limited at 470 mg/m3. CO is limited at 870 mg/m3.

Each factory does the same way in air treatment. For example, every factory invested on the “multi cyclone”, “wet scrubbers”, boiler, fan and others to obstruct and reduce the dust release from the burning process of boiling pot machine to the outside. The cost of exhaust air treatment is around 36,000 to 110,000 Baht per year. Some factories plan to bring charcoal to burn as the energy to run the processing. The factories plan to minimize the impact of expected future problem of the treatment system by investing on the
“Electrostatic precipitator” in order to eliminate sulfur dioxide. Therefore, the cost of treatment will be high as well.

7.10.3 Residual control

According the residual, there is the regulation concerning residuals from the sugar production process (mud, carbon). Ministry of Industry issue the 6th announcement of year 1997 and the industrial law of the year 1992 in the issue of the treatment of the elimination of the residuals, waste from the sugar production process. In the sugar production process, there will be residual around 30,625 tons or 1-2% of total sugarcane. It consists of soil, stone, sand, iron, ash and tilter aid. It is limited the quantity of lead subacetate. At present, there is the law not allow to use the lead. In the past, there was the system to measure the residual value. At present, government office changes to responses. Genco laboratory or general environmental conservation public company limited is responding to measure the residual of all factories. It is the government authorized industrial waste treatment facility of Thailand.

Therefore, sugar factories do the same in residual treatment by putting them on the land, settled them, treatment, keep them and then send to Genco residual treatment company to eliminate them. The ash, filter and sand are leaved to dry and will be sent to fill the land. The filter cake as the natural waste will be sent to sugarcane grower to use it as the fertilizer. The steel residual will be sent to steel industry. The process of residual treatment needs the machine to shake the sand before bring them to the land. Therefore, it is costly. The cost of the residual treatment of factory is around 65,000 to 200,000 Baht per year. Some factories have to pay very high for the residual transportation cost up to 100,000 Baht.

7.11 Problems and obstructions of the sugar industry

The analysis of problems and obstructions of sugar industry divided the problem into economic problems, processing problems, market problems, regulation problems, and management problems.

Many factories expect to face many different problems in the future that are, the economic problem such as money shortage, uncertainty of economy, low price of sugar. Many factories report to face the problem of low price of sugar. The processing problem, the factories expect to face the problem of lacking of

---

14 The waste that is not sugarcane juice will be settled. Then, the factory will dump them and mix them to be “Filter cake”.

Profitability of Sugarcane Production in Thailand
input supply, higher cost of input, higher energy cost and higher cost of production. Within market problem such as market share, competition from domestic and outside, the variety of substitution product, most factories report the high competition from foreign country is important. Two factories expect to face governmental regulation problems in the future. The managerial problem, lack of labour and high labour cost are the main important problem the factories recognize (Table 7.11).

Moreover, some factories gave the opinion that governmental policy causes problems. For example, the government allows setting new factories but the government controls the sugarcane planting and production. When sugarcane growers harvest, they need to calculate how many days sugarcane can wait before going to the factory.

Table 7.11 Analysis of the problems and obstruction of sugar factories

<table>
<thead>
<tr>
<th>Problem of factory</th>
<th>Factory A</th>
<th>Factory B</th>
<th>Factory C</th>
<th>Factory D</th>
<th>Factory E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic problem</td>
<td>Low price of sugar</td>
<td>-</td>
<td>Low price of sugar</td>
<td>-</td>
<td>Low price of sugar</td>
</tr>
<tr>
<td>Processing problem</td>
<td>Higher energy cost</td>
<td>-</td>
<td>Higher cost of input supply</td>
<td>-</td>
<td>Lack of input supply</td>
</tr>
<tr>
<td></td>
<td>Higher cost of production</td>
<td>-</td>
<td>Higher energy cost</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Market problem</td>
<td>Low market share</td>
<td>-</td>
<td>High competition from foreign country</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>High competition from foreign country</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Regulation problem</td>
<td>Government regulation</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Managerial problem</td>
<td>Lack of labor</td>
<td>-</td>
<td>High labor cost</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>High labor cost</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: own survey.
Altogether, it can be summarized that most of the factories expect high impacts on their business due to the expected problems and obstructions (Table 7.12). Only one factory expects low impact on its business.

### Table 7.12 Effect of problems the factories expect to encounter in the future

<table>
<thead>
<tr>
<th>Level of expected problem</th>
<th>Factory A</th>
<th>Factory B</th>
<th>Factory C</th>
<th>Factory D</th>
<th>Factory E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very high</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>x</td>
<td>n.a.</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lowest</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

Source: own survey.

### 7.12 Suggestion of ways to solve the problems and future strategies of the sugar industry

At present, sugarcane farmers face the problem of deficit budget and many farmers leave away. Sugar factories need to solve the problem by promoting sugarcane growers to continually grow sugarcane. The labour cost problem should be solved. Otherwise, it will be a big problem for the sugar industry in the future. Moreover, sugar factories should increase the yield enhancement and the efficiency of the factory. Some factories have the opinion that sugar should be produced for exportation purpose.

Another problem of the sugar industry is the production cost problem; the factories should increase the efficiency in using energy. Moreover, increasing the quality of the product is important.

Quota systems are a good alternative way to solve the insufficient of sugar cane supply. It can ensure sufficient and regular supply to the sugar cane factories.

Some sugar factories plan to establish a power system supply and to run an ethanol plant to increase the value added of the production. However, it is still a project for the future.
7.13 Conclusion

The determination of competitiveness of the sugar industry in Thailand in this study applies various indicators that influence competitiveness in the sugar industry. Several indicators that are used to describe competitiveness are sugarcane supplier, sugar sales, the distance of sugarcane transporting to factory, productivity indicators, extraction rate of sugar per ton of sugarcane, cost of sugar production and processing, profitability of sugar production, environmental regulation.

Sugarcane supplier is important for the competitiveness indirectly because if the factory can deal with the large sugarcane supplier who can supply large amount of sugarcane for crushing process. The factory will advantage in management easily and the productivity will increase due to the time saving from the long queue of sugarcane deliver.

Sugar sales increase with increasing sugar extraction rate and sugar quality. The higher the sugar sales per unit of input, the higher the competitiveness.

Distance of sugarcane transportation is another factor influence on industry competitiveness. The average distance of sampling factory deliver sugarcane from sugarcane farmer is average 53.33 km. and the average distance sugarcane transport from factory own farm is 31.88 km. Therefore, the closer the distance of sugarcane transportation, the more advantage the factory will get.

Productivity indicators measure in unit of kilogram per rai of sugarcane. It relates to competitiveness. It found that factory C possesses an advantage with respect to kilogram of total sugar production per rai in production year 2002/03 and 2003/04.

Extraction rate of sugar production show the comparative competitiveness of sugar industries. It presents that how many kilogram of sugar production the sugar industry can produce per one ton of sugarcane. Factory E has highest ETR account for 114 kg/ton of sugarcane in the production year 2003/04. This means that factory E input 1 ton of sugarcane and received the total of sugar production 114 kg.

Cost of sugar production indicates the competitiveness when the factory can minimize cost. It found that the average cost of sugar production was at 9.41 Baht/kg in 2002/03 and it declined to 8.27 Baht/kg in 2003/04. In 2002/03, factory B had the lowest cost of sugar production at 7.01 Baht/kg, while factory D had the lowest cost of sugar production in 2003/04 at 6.41 Baht/kg.

Profitability of sugar production illustrates the ability of factory to gain the profit when compare to other factories. The profit of sugar production was at average 0.21 Baht/kg in 2002/03 and at average 0.45 Baht/kg.
8 SUMMARY AND CONCLUSIONS

Thailand is now firmly established as one of the world’s leading sugar exporting countries. During 1995/96 to 2005/06, sugar exports ranged between 2.3 and 5.1 million tons and averaged 3.80 million tons per year. For this reason, sugar cane production is one of the major economic sectors in Thailand. There are several activities involved in the production process such as sugarcane growing, sugar milling, credit banking, exportation, etc. The sugar production activities provide significant full time and temporary employment in sugar factories, sugar transformation, transportation and exports. Therefore, the study of sugar cane and sugar industry’s competitiveness is important, especially with the increasing liberalisation of the world market.

The overall objectives of this research are to analyse the competitiveness of the sugar industry in Thailand. This thesis combines an in-depth sugarcane farm and sugar industry interview with a qualitative and quantitative data analysis. Based on the above considerations, this thesis has key objectives as follows:

1. To study the structure of sugarcane and sugar production in Thailand
2. To analyse costs and returns of sugarcane and sugar production in Thailand.
3. To examine the competitiveness of the sugar industry and identify indicators of competitiveness.
4. To describe strategies of sugarcane growers and sugar factories for improving competitiveness.

This study focuses on comparing the costs and returns between sugarcane and its competing crops in Thailand. Field surveys and interviews have been carried out with people involved in sugarcane production activities. Additional secondary data were reviewed to support the research.

The methodology applied for the farm sampling is based on the concept of typical farm approach. Farm types are determined by sugarcane experts taking into consideration: location of farm, farm size, sugarcane area and share of rain-fed and irrigated area. The first category of farms was chosen to represent the size that is close to the statistical average. The other types defined represent larger farms to allow the exploration of potentials for economies of size in the region. Management levels on the typical farms are above average. The sugar factories were categorized by region, industry group and crushing capacity.

The data source used in this study consists of both primary and secondary data. The primary data was collected by the use of questionnaires, which were divided into farm and industry questionnaires. Data was collected in the crop year of 2003/04. With the farm questionnaire, information was collected on farm structure, capacity of machinery and buildings, labour organization, factor costs and returns of sugarcane production, profitability of competing crops, irrigation methods and future farm strategies. With the factory questionnaire, data was
collected on the company profile, cost of sugarcane transport from sugarcane field to factory gate, factory processing costs, environmental regulations and future factory strategies. The secondary data has the purpose to analyze the competitiveness of the whole sugar industry in Thailand, which was collected from sources such as the Office of Cane and Sugar Board (OCSB), Office of Agricultural Economics (OAE), Association of the sugar industry, Association of sugarcane growers, sugar factories, sugarcane growers, and sugar traders. The analysis of secondary data used data from 1982 to 2006.

This research work was conducted in Central, Northeastern and Northern Thailand. The study area consists of 9 provinces in 3 regions. There are 3 provinces in the Northeast region, which are Khon Kaen, Burirum and Udonthani province. There are 2 provinces in the North region, which are Nakhon Sawan, and Phitsanulok province and there are 4 provinces in the Central region, which are Kanchanaburi, Nakhon Pathom, Bangkok and Prachuapkhiriikhan province.

With the first questionnaire, data were collected by interviewing sugar cane farmers in the North, Central, and Northeastern region. The random sample consists of 29 sugar cane farmers: 7 Northern farms, 10 Central farms, and 12 Northeastern farms. Primary data from the second questionnaire of sugar factories was collected in the same regions. The questionnaires were sent to 46 sugar factories. Only five of them responded. Among these, there are one large factory and four small factories.

Firstly, the structure of sugar cane production in Thailand can be described as follows. Sugar cane is grown all over the country. The total cane area amounted to 6.34 million rai in 2004/05. The most important regions of sugar cane production are the Northeastern, the Central and the Northern region. The total cane production amounted to 47.82 million tons in 2004/05 with an average yield of 7.54 tons/rai. More than 80% of the total number of sugar cane growers in Thailand (174,326) are small farms with less than 59 rai of sugar cane area. 87% of the cane growers produce under rainfed conditions; only 13% are irrigating their sugar cane area. Irrigation is mostly used in the Central region, where 27% of the sugarcane growers irrigate their cane land. Sugarcane planting starts in October and is possible until May. The harvest period lasts from December to April. Sugar cane is usually planted for two to three rations.

Secondly, the structure of the sugar industry in Thailand can be described as follows. Within the total number of 46 sugar factories, there are 4 large factories with a crushing capacity of more than 24,000 tons of cane crushed per day, 16 medium size factories (12,000-24,000 tons/day), and 26 small size factories (< 12,000 tons/day).

Thirdly, the sugar market in Thailand can be described as follows. The total sugar production amounted to 7 million tons in 2003/04. With a share of domestic consumption of 27.8%, only around 2 million tons of sugar is used for domestic consumption. The rest of around 5 million tons of sugar is exported to
the world market, mostly to Asia. The wholesale prices for the domestic market are annually fixed by the government to around 12 Baht/kg in the average.

**Fourthly**, the results of sugarcane farms can be concluded as follows.

The analysis of sugarcane **costs** of production has shown that the total production costs of sugarcane farms for the first ratoon are highest and then decrease in the second and third ratoon. The farms in the Central region have higher average production costs (4,245 Baht/rai) than the cane growers in the Northeast (4,130 Baht/rai) and in the North (3,725 Baht/rai). Low labor costs, especially harvesting costs of around 1,142 Baht per rai, are the predominant reason for the lower cost structure of the farms in the Northeastern region.

The analysis of total **revenues** of sugarcane production has shown that on the average, sugarcane farmers benefit a lot from investing in the first ratoon (around 5,589 Baht per rai). However, the revenue decreases with the yield, especially in the third ratoon. This is probably a reason for the farmers in the Northeast region not to plant sugarcane in the third ratoon. The highest yields and revenues are achieved in the Central region.

The analysis of **profitability** of sugarcane production has shown that the average total profit of sugarcane farms over all regions in the second and third ratoon let sugarcane farmers get the highest profit of more than 2,000 Baht per rai, while sugarcane planting in the first ratoon gives farmers less profit (208 Baht per rai). Considering the average total profit of sugarcane planting over all ratoons and regions, it is found that the Central region has the highest average total profit of around 1,859 Baht per rai. The Northern and Northeastern region gain less profit of 1,171 and 890 Baht per rai.

The analysis of **break-even yields and break-even prices** indicated that the average break-even yield for the third ratoon of sugarcane production is the lowest with 6.1 tons/rai. This means that sugarcane farmers would already reach the break-even point for recovering all costs if they only produce 6.1 tons/rai. According to break-even yields by region, sugarcane farmers in the North have the lowest break-even yields (7.5 tons/rai). Thus, sugarcane farmers in the North have the highest competitiveness in sugarcane production, concerning production costs.

The break-even price analysis shows that the break-even price decreases with every ratoon. Sugarcane in the third ratoon has an average break-even price of 269.3 Baht/ton, while sugarcane in the first ratoon has an average break-even price of 469.1 Baht/ton. Therefore, the continuing of cane growing until the third ratoon is a good choice because sugarcane farmers can make increasing profits. When break-even prices are compared by region, there is no big difference. They range between 331.6 and 377.6 Baht/ton.

The comparison of **gross margins** of sugarcane production shows that the average gross margin in the first ratoon (769 Baht/rai) is much lower than in other ratoons. The average gross margin of the second and third ratoon equals to 2,608 and 2,618 Bath per rai. Looking at regions, in the production year 2003/04
sugarcane farms in the Central region attained the highest average gross margin (2,537.7 Baht/rai), while sugarcane farmers in the North and Northeast earned an average gross margin of 1,590 and 1,492.5 Baht/rai respectively.

The comparison of sugarcane production and competing crops has shown that there are four main competing crops of sugarcane, which are rice, pineapple, cassava and maize. However, sugarcane production in Thailand is still the key crop for sugarcane farmers. The secondary crops can not be perfect substitutes, because of natural and market conditions. Rice can only be planted in low land and it needs plenty of water. Pineapple can be planted only in some provinces. Cassava planting may cause the problem of soil and lower gross margins. Maize prices give only a low incentive for sugarcane farmers to switch from cane to maize. Therefore, sugarcane production is expected to be important further on and can compete with other crops.

Fifthly, the results of the sugar factory analysis can be concluded as follows.

The five investigated factories are one large factory with a crushing capacity of more than 23,000 tons of cane per day, and four small factories with a cane crushing capacity of less than 12,000 tons/day. Although most of the cane suppliers are small size farmers, the majority of cane comes from medium and large farms.

The sugar sales are depending on the type of sugar and the market channel and range from 14 Baht/kg to 18 Baht/kg.

The average distance of sugarcane transport is around 53.33 km for sugarcane which is purchased from sugarcane farmers. The closer the sugarcane fields to the factory are the higher is the competitiveness of the sugar factory.

The productivity analysis of the sugar industry shows that factory C possesses an advantage with respect to the quantities of total sugar production per rai in production year 2002/03 and 2003/04.

The analysis of extraction rates of sugar per ton of sugarcane shows that the average extraction rate of the investigated factories are about 96.68 kg of sugar per ton of sugarcane in the production year 2002/03 and increased to 106.72 kg of sugar per ton of sugarcane in the production year 2003/04.

The analysis of sugar production costs shows that the average variable costs of sugar production amounted to 9.41 Baht/kg in 2002/03 and declined to 8.27 Baht/kg in 2003/04. In 2002/03, factory B had the lowest costs of sugar production with 7.01 Baht/kg, while factory D had the lowest costs of sugar production in 2003/04 with 6.41 Baht/kg.

The profitability analysis of sugar production shows that sugar producers made an average profit of sugar production of 0.21 Baht/kg in the production year 2002/03. Then, the average profit of sugar production increased to 0.45 Baht/kg in production year 2003/04.

The result of ranking the sugar factories according to their competitiveness shows that factory C has an advantage in the total quantity of
Summary and Conclusions

sugar production per rai. Factory E had the highest advantage in the extraction rate of sugar per ton of sugar cane and gained the highest profit of sugar production. However, factory B has the highest ability to produce sugar with the lowest costs per kg and factory D was the leader in reducing costs of sugar production in Baht per rai. In the summary, the score over all indicators of competitiveness shows that factory E has the highest score. Therefore, factory E has been ranked to be the most competitive factory, followed by factory B, factory D, factory A, and factory C respectively.

The analysis of problems and obstructions of the sugar industry divided the problem into economic problems, processing problems, market problems, regulation problems, and management problems. Many factories expect to face many different problems in the future. The main economic problems are money shortage, uncertainty of economy and low price of sugar. Concerning processing problems, the factories expect to face problems of lacking of input supply, increasing input costs, energy costs and costs of production. Within market problems, such as market share, domestic and foreign competition and product substitution are important. Two factories expect to face governmental regulation problems in the future. Concerning managerial problems, the lack of labour and high labour costs are the most important problems the factories fear.

Finally, this study provides suggestions and policy recommendations for sugarcane farms and sugar factories in four areas. First, sugarcane productivity per rai is still low in Thailand, therefore research and development is necessary in the field of optimization of the production process and breeding of new sugarcane varieties. Second, enough water and access to irrigation system is very important for sugarcane planting, so the government should help to provide these facilities for the farmers. Third, the sugar industry should differentiate their sugar products in order to increase the value added of sugar production. This will help sugar factories in case of encountering the situation of low prices of sugar. Fourth, due to increasing energy costs, sugar factories should get support in acquiring alternative energies and reducing other costs of production by research and development.
9 GERMAN SUMMARY (Deutsche Zusammenfassung)


Die übergeordnete Zielsetzung dieser Studie ist, die Wettbewerbsfähigkeit der Zuckerindustrie in Thailand zu analysieren. Die Studie kombiniert eine eingehende empirische Datenerhebung in Zuckerrohrbetrieben und Zuckerfabriken mit einer qualitativen und quantitativen Datenanalyse. Basierend auf den oben genannten Betrachtungen, hat vorliegende Arbeit folgende Hauptziele:

1. Die Struktur des Zuckerrohranbaus und der Zuckererzeugung in Thailand zu untersuchen.
3. Die Wettbewerbsfähigkeit der Zuckerindustrie zu untersuchen und Indikatoren für die Wettbewerbsfähigkeit zu identifizieren.
4. Strategien der Zuckerrohranbauer und der Zuckerfabriken zur Verbesserung der Wettbewerbsfähigkeit zu analysieren.


Die angewandte Methode zur Stichprobenauswahl basiert auf dem Konzept des typischen Betriebes („typical farm approach“). Die zu betrachtenden Betriebstypen wurden von Zuckerrohrexper ten hinsichtlich Region, Betriebsgröße, Zuckerrohranbaufläche und Anteil der Bewässerungsfläche definiert. Die erste Betriebsgruppe soll den statistischen Durchschnitt repräsentieren. Darüber hinaus wurden größere Betriebe in die Erhebung miteinbezogen, um im Rahmen des Strukturwandels das künftige
Potenzial in der Region abschätzen zu können. Das Management der ausgewählten Betriebe ist überdurchschnittlich. Die zu befragenden Zuckerfabriken wurden nach Region, Unternehmensgruppe und Verarbeitungskapazität kategorisiert.


**Zweitens** kann die Struktur der Zuckerindustrie in Thailand wie folgt beschrieben werden. Unter den 46 Zuckerfabriken sind vier große Fabriken mit einer Verarbeitungskapazität von mehr als 24000 t Zuckerrohr pro Tag, 16 mittelgroße Fabriken (12000 bis 24000 t Zuckerrohr pro Tag) und 26 kleine Fabriken (weniger als 12000 t Zuckerrohr pro Tag).


Die Analyse der **Break-even Ertäge** und der **Break-even Preise** hat gezeigt, dass der Break-even Ertrag im dritten Jahr der Zuckerrohrproduktion mit 6,1 t/rai am niedrigsten ist. Das heißt, dass bereits ab einem Ertrag von 6,1 t/rai die gesamten Produktionskosten der Zuckerrohranbauer gedeckt sind. In Bezug auf die Regionen ist der Break-even Ertrag der Zuckerrohranbauer in der Nordregion mit 7,5 t/rai am niedrigsten. Folglich haben die Betriebe im Norden in Bezug auf die Produktionskosten die höchste Wettbewerbsfähigkeit in der Zuckerrohrproduktion.

Die Analyse der Break-even Preise hat gezeigt, dass sich die Break-even Preise mit jedem Jahr der Nutzung einer Zuckerrohrplantage vermindern. Im dritten Jahr der Nutzung liegt der Break-even Preis bei 269,3 Baht/t im Durchschnitt aller Regionen, während er im ersten Jahr 469,1 Baht/t beträgt. Unter diesen Bedingungen ist es wirtschaftlich, eine Zuckerrohrplantage bis zur dritten Ernte zu nutzen. In regionaler Hinsicht zeigen sich keine großen Unterschiede in den Break-even Preisen. Sie bewegen sich im Durchschnitt aller Jahre zwischen 331,6 und 377,6 Baht/t in den einzelnen Regionen.


**Fünftens** können die Befragungsergebnisse der Zuckerfabriken wie folgt zusammengefasst werden. Die fünf ausgewerteten Fabriken setzen sich aus einer großen Fabrik mit einer **Verarbeitungskapazität** von mehr als 23000 t Zuckerrohr pro Tag und vier kleinen Fabriken mit einer Verarbeitungskapazität von weniger als 12000 t Zuckerrohr pro Tag zusammen. Obwohl die meisten **Zuckerrohrlieferanten** kleine Betriebe sind, stammt der Großteil des

Die Produktivitätsanalyse der Zuckerindustrie hat gezeigt, dass Fabrik C in den Jahren 2002/03 und 2003/04 von allen untersuchten Fabriken die höchste Zuckermenge pro Einheit Zuckerrohranbaufläche (rai) erzeugte.

Die Analyse der Zuckerausbeute hat gezeigt, dass die durchschnittliche Zuckerausbeute der fünf untersuchten Fabriken im Jahr 2002/03 bei 96,7 kg Zucker pro t Zuckerrohr lag und im Folgejahr auf 106,7 kg anstieg.

Die Analyse der Zuckererzeugungskosten hat gezeigt, dass die variablen Kosten der Zuckererzeugung im Jahr 2002/03 im Durchschnitt der befragte Zuckerfabriken bei 9,41 Baht/kg lagen und im Folgejahr auf 8,27 Baht/kg zurückgingen. Im Jahr 2002/03 hatte Fabrik B mit 7,01 Baht/kg die geringsten Zuckererzeugungskosten; im Folgejahr war es Fabrik D mit 6,41 Baht/kg.

Die Rentabilitätsanalyse der Zuckererzeugung hat gezeigt, dass die fünf befragten Zuckerfabriken im Jahr 2002/03 einen durchschnittlichen Gewinn von 0,21 Baht/kg erzielten. Im Folgejahr stieg er auf 0,45 Baht/kg an.

Das Ranking der Zuckerfabriken hinsichtlich ihrer Wettbewerbsfähigkeit hat gezeigt, dass Fabrik C die höchste Zuckermenge je Einheit Zuckerrohranbaufläche erzeugt. Fabrik E realisiert die höchste Zuckerausbeute und erzielt den höchsten Gewinn je kg Zucker. Fabrik B realisiert die geringsten Produktionskosten je kg Zucker und Fabrik D hat die geringsten Zuckerproduktionskosten je Einheit Zuckerrohranbaufläche. Insgesamt erzielt Fabrik E die höchste Punktzahl bei der Summe aller Wettbewerbsindikatoren und erzielt das beste Ranking hinsichtlich der Wettbewerbsfähigkeit, gefolgt von den Fabriken B, D, A und C.

Auflagen. Hinsichtlich Managementschwierigkeiten sind Arbeitskräftemangel und hohe Lohnkosten die Hauptprobleme, die die Zuckerfabriken befürchten.

APPENDIX

Appendix to chapter 5 ................................................................. 150
Appendix to chapter 6 ................................................................. 152
Appendix to chapter 7 ................................................................. 169
### Appendix to chapter 5

#### Appendix-Table 5.1: Recommended varieties of Thai sugarcane

<table>
<thead>
<tr>
<th>Variety(parentage)</th>
<th>Description</th>
<th>Recommendation</th>
<th>Year released</th>
</tr>
</thead>
<tbody>
<tr>
<td>U Thong 1 (Open-Cross of F 172)</td>
<td>- High yielding (120 t/ha) - Medium CCS (11-12) - Good tillering - Good rationing - Smut resistance - Moderate drought tolerance - Harvesting age 11-13 months</td>
<td>- Loamy soil - Mid-Late milling season - Central, Northeast and East regions</td>
<td>1986 Released by the Department of Agriculture, Ministry of Agriculture and Co-operatives</td>
</tr>
<tr>
<td>U Thong 2 (IAC 52-326Open-Cross)</td>
<td>- High yielding (100 t/ha) - High CCS (12-14) - Early sugar accumulation - Smut resistance - Harvesting period 9-11 months</td>
<td>- Loamy soil - Early milling season</td>
<td>1995 Released by the Department of Agriculture, Ministry of Agriculture and Co-operatives</td>
</tr>
<tr>
<td>U Thong 3 (U Thong 1 x U Thong 2)</td>
<td>- High yielding (100 t/ha) - High CCS (12-14) - Good tillering - Good rationing - Smut resistance - Green grassy shoot tolerance - Early flowering - Harvesting age 10-12 months</td>
<td>- Loam soil - Irrigated or semi-irrigated area - Central and Central North region - Not recommended for red rot wilt infested areas.</td>
<td>1998 Released by the Department of Agriculture, Ministry of Agriculture and Co-operatives</td>
</tr>
<tr>
<td>K 90-77 (K83-77 x U Thong 1)</td>
<td>- High yielding (110 t/ha) - High CCS (13-15) - Good rationing - Drought tolerance - Red rot wilt resistant - Non-flowering - Harvesting age 12 months</td>
<td>- Loam, Sandy loam - Late – milling - Rain-fed area</td>
<td>1999 Released by the Ministry of Industry</td>
</tr>
</tbody>
</table>
### Appendix-Table 5.1: Recommended varieties of Thai sugarcane (Continue)

<table>
<thead>
<tr>
<th>Variety (parentage)</th>
<th>Description</th>
<th>Recommendation</th>
<th>Year released</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phil 54-60 x Co 440</td>
<td>- Yield (80 t/ha) &lt;br&gt; - Medium CCS (10-12) &lt;br&gt; - Good tillering &lt;br&gt; - Good rationing &lt;br&gt; - Drought tolerance &lt;br&gt; - Harvesting age 11-12 months</td>
<td>- Loam soil &lt;br&gt; - Loamy sand soil &lt;br&gt; - Northeast region</td>
<td>Introduced varieties</td>
</tr>
<tr>
<td>Phil 58-260 (Q 47 x POJ 3016)</td>
<td>- Yield (80 t/ha) &lt;br&gt; - CCS (10-14) &lt;br&gt; - Good tillering &lt;br&gt; - Non-flowering &lt;br&gt; - Medium drought tolerance &lt;br&gt; - Harvesting age 11-12 months</td>
<td>- Loamy sand soil &lt;br&gt; - Clay loam soil &lt;br&gt; - Northeast region</td>
<td>Introduced varieties</td>
</tr>
</tbody>
</table>

## Appendix to chapter 6

### Appendix-Table 6.1: Structure of the sample farms

<table>
<thead>
<tr>
<th>Farm</th>
<th>Total agricultural area (rai)</th>
<th>Sugarcane area (rai)</th>
<th>Ratoons (number)</th>
<th>Rice (rai)</th>
<th>Cassava (rai)</th>
<th>Pineapple (rai)</th>
<th>Corn (rai)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N1</td>
<td>2500</td>
<td>2000</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>N2</td>
<td>95</td>
<td>70</td>
<td>2</td>
<td>25</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>N3</td>
<td>94</td>
<td>64</td>
<td>3</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>N4</td>
<td>58</td>
<td>58</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>N5</td>
<td>58</td>
<td>47</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>N6</td>
<td>46</td>
<td>36</td>
<td>3</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>N7</td>
<td>20</td>
<td>20</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NE1</td>
<td>1000</td>
<td>1000</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NE2</td>
<td>600</td>
<td>600</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NE3</td>
<td>350</td>
<td>350</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NE4</td>
<td>200</td>
<td>200</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NE5</td>
<td>200</td>
<td>150</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NE6</td>
<td>75</td>
<td>56</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NE7</td>
<td>26</td>
<td>16</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NE8</td>
<td>13</td>
<td>13</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NE9</td>
<td>20</td>
<td>10</td>
<td>2</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NE10</td>
<td>40</td>
<td>10</td>
<td>1</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>C1</td>
<td>1350</td>
<td>930</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>350</td>
<td>0</td>
</tr>
<tr>
<td>C2</td>
<td>290</td>
<td>224</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>40</td>
<td>0</td>
</tr>
<tr>
<td>C3</td>
<td>300</td>
<td>70</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>C4</td>
<td>50</td>
<td>30</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>C5</td>
<td>55</td>
<td>44</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>C6</td>
<td>30</td>
<td>25</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>C7</td>
<td>30</td>
<td>30</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>C8</td>
<td>20</td>
<td>20</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>C9</td>
<td>38</td>
<td>30</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>C10</td>
<td>100</td>
<td>100</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>C11</td>
<td>82</td>
<td>79</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>C12</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Region</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>410</td>
<td>328</td>
<td>2.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northeast</td>
<td>252</td>
<td>241</td>
<td>1.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central</td>
<td>196</td>
<td>132</td>
<td>2.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>286</td>
<td>234</td>
<td>2.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Source:** Own survey (2004)
Appendix-Table 6.2: Total cost of sugarcane farms for the first ratoon

<table>
<thead>
<tr>
<th></th>
<th>N1</th>
<th>N2</th>
<th>N3</th>
<th>N4</th>
<th>N5</th>
<th>N6</th>
<th>N7</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cash cost</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Variable cost (Baht/rai)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 Labour cost (Baht/rai)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Soil Preparation</td>
<td>397</td>
<td>550</td>
<td>550</td>
<td>550</td>
<td>640</td>
<td>330</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>B. Soil improvement</td>
<td>62</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>C. Breed preparation</td>
<td>129</td>
<td>-</td>
<td>264</td>
<td>200</td>
<td>238</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>D. Planting</td>
<td>180</td>
<td>130</td>
<td>189</td>
<td>157</td>
<td>150</td>
<td>640</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>E. Fertilizing</td>
<td>210</td>
<td>84</td>
<td>10</td>
<td>100</td>
<td>200</td>
<td>130</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>F. Chemical application</td>
<td>100</td>
<td>120</td>
<td>58</td>
<td>106</td>
<td>120</td>
<td>140</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>G. Watering</td>
<td>16</td>
<td>-</td>
<td>-</td>
<td>83</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>H. Weeding</td>
<td>130</td>
<td>240</td>
<td>-</td>
<td>248</td>
<td>214</td>
<td>107</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>I. Harvesting</td>
<td>1,105</td>
<td>1,517</td>
<td>1,300</td>
<td>1,203</td>
<td>1,200</td>
<td>1,600</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>1.2 Factor cost (Baht/rai)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Breeding cost</td>
<td>-</td>
<td>1,543</td>
<td>1,296</td>
<td>1,200</td>
<td>857</td>
<td>1,589</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>B. Fertilizer use</td>
<td>676</td>
<td>568</td>
<td>743</td>
<td>861</td>
<td>850</td>
<td>818</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>C. Chemical use</td>
<td>170</td>
<td>296</td>
<td>175</td>
<td>252</td>
<td>189</td>
<td>280</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>D. Watering cost</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>E. Fuel and lubricant cost</td>
<td>44</td>
<td>61</td>
<td>142</td>
<td>57</td>
<td>-</td>
<td>87</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>F. Management cost</td>
<td>18</td>
<td>34</td>
<td>30</td>
<td>13</td>
<td>37</td>
<td>13</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>G. Maintenance Cost</td>
<td>8</td>
<td>129</td>
<td>79</td>
<td>125</td>
<td>6</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>2. Fixed cost (Baht/rai)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land use cost</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1,000</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Total cash costs (Baht/rai)</td>
<td>3,245</td>
<td>5,270</td>
<td>4,836</td>
<td>5,156</td>
<td>5,700</td>
<td>5,734</td>
<td>-</td>
<td>4,990</td>
</tr>
<tr>
<td>Total cash costs (Baht/ton)</td>
<td>361</td>
<td>450</td>
<td>484</td>
<td>469</td>
<td>475</td>
<td>521</td>
<td>-</td>
<td>460</td>
</tr>
<tr>
<td><strong>Non cash cost</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>42</td>
<td>39</td>
<td>127</td>
<td>146</td>
<td>75</td>
<td>55</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Opportunity cost of capital</td>
<td>210</td>
<td>187</td>
<td>289</td>
<td>267</td>
<td>266</td>
<td>240</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Total non cash costs (Baht/rai)</td>
<td>252</td>
<td>226</td>
<td>416</td>
<td>413</td>
<td>341</td>
<td>295</td>
<td>-</td>
<td>324</td>
</tr>
<tr>
<td>Total non cash costs (Baht/ton)</td>
<td>28</td>
<td>19</td>
<td>42</td>
<td>38</td>
<td>28</td>
<td>27</td>
<td>-</td>
<td>30</td>
</tr>
<tr>
<td><strong>Total cost</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Cost/rai (Bath/rai)</td>
<td>3,497</td>
<td>5,496</td>
<td>5,252</td>
<td>5,568</td>
<td>6,041</td>
<td>6,029</td>
<td>-</td>
<td>5,314</td>
</tr>
<tr>
<td>Total Cost/ton (Bath/ton)</td>
<td>389</td>
<td>470</td>
<td>525</td>
<td>506</td>
<td>503</td>
<td>548</td>
<td>-</td>
<td>490</td>
</tr>
<tr>
<td>Yield per rai (Tons/rai)</td>
<td>9</td>
<td>12</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>11</td>
<td>-</td>
<td>10.8</td>
</tr>
<tr>
<td>Cane price (Baht/ton)</td>
<td>520</td>
<td>489</td>
<td>460</td>
<td>467</td>
<td>455</td>
<td>450</td>
<td>-</td>
<td>473.5</td>
</tr>
<tr>
<td>Total revenue (Baht/rai)</td>
<td>4,680</td>
<td>5,723</td>
<td>4,599</td>
<td>5,135</td>
<td>5,460</td>
<td>4,950</td>
<td>-</td>
<td>5,091</td>
</tr>
<tr>
<td>Accounting profit (Baht/rai)</td>
<td>1,393</td>
<td>414</td>
<td>-364</td>
<td>-167</td>
<td>-315</td>
<td>-839</td>
<td>-</td>
<td>21</td>
</tr>
<tr>
<td>Economic profit (Baht/rai)</td>
<td>1,183</td>
<td>227</td>
<td>-653</td>
<td>-433</td>
<td>-581</td>
<td>-1,079</td>
<td>-</td>
<td>-223</td>
</tr>
</tbody>
</table>

**Source:** Own survey (2004)
Appendix-Table 6.2: Total cost of sugarcane farms for the first ratoon (continue)

<table>
<thead>
<tr>
<th>Cash cost</th>
<th>Norweset</th>
<th>NE1</th>
<th>NE2</th>
<th>NE3</th>
<th>NE4</th>
<th>NE5</th>
<th>NE6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Variable cost (Baht/rai)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 Labour cost (Baht/rai)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Soil Preparation</td>
<td>356</td>
<td>388</td>
<td>510</td>
<td>508</td>
<td>430</td>
<td>540</td>
<td></td>
</tr>
<tr>
<td>B. Soil improvement</td>
<td>88</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>C. Breed preparation</td>
<td>253</td>
<td>248</td>
<td>340</td>
<td>418</td>
<td>270</td>
<td>339</td>
<td></td>
</tr>
<tr>
<td>D. Planting</td>
<td>537</td>
<td>436</td>
<td>225</td>
<td>200</td>
<td>300</td>
<td>226</td>
<td></td>
</tr>
<tr>
<td>E. Fertilizing</td>
<td>20</td>
<td>21</td>
<td>20</td>
<td>20</td>
<td>35</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>F. Chemical application</td>
<td>100</td>
<td>80</td>
<td>70</td>
<td>100</td>
<td>100</td>
<td>108</td>
<td></td>
</tr>
<tr>
<td>G. Watering</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>H. Weeding</td>
<td>700</td>
<td>696</td>
<td>100</td>
<td>150</td>
<td>320</td>
<td>240</td>
<td></td>
</tr>
<tr>
<td>I. Harvesting</td>
<td>1,210</td>
<td>1,314</td>
<td>1,150</td>
<td>1,365</td>
<td>1,058</td>
<td>1,100</td>
<td></td>
</tr>
<tr>
<td>1.2 Factor cost (Baht/rai)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Breeding cost</td>
<td>682</td>
<td>900</td>
<td>720</td>
<td>1,105</td>
<td>600</td>
<td>875</td>
<td></td>
</tr>
<tr>
<td>B. Fertilizer use</td>
<td>890</td>
<td>668</td>
<td>890</td>
<td>950</td>
<td>890</td>
<td>880</td>
<td></td>
</tr>
<tr>
<td>C. Chemical use</td>
<td>750</td>
<td>230</td>
<td>-</td>
<td>210</td>
<td>75</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>D. Watering cost</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>E. Fuel and lubricant cost</td>
<td>12</td>
<td>133</td>
<td>69</td>
<td>165</td>
<td>23</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>F. Management cost</td>
<td>106</td>
<td>137</td>
<td>21</td>
<td>25</td>
<td>33</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>G. Maintenance Cost</td>
<td>64</td>
<td>86</td>
<td>-</td>
<td>-</td>
<td>138</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>2. Fixed cost (Baht/rai)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land use cost</td>
<td>700</td>
<td>-</td>
<td>700</td>
<td>-</td>
<td>300</td>
<td>700</td>
<td></td>
</tr>
<tr>
<td>Total cash costs (Baht/rai)</td>
<td>6,466</td>
<td>5,336</td>
<td>4,815</td>
<td>5,216</td>
<td>4,570</td>
<td>5,164</td>
<td></td>
</tr>
<tr>
<td>Total cash costs (Baht/ton)</td>
<td>588</td>
<td>445</td>
<td>438</td>
<td>401</td>
<td>481</td>
<td>420</td>
<td></td>
</tr>
<tr>
<td>Non cash cost</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>167</td>
<td>156</td>
<td>193</td>
<td>273</td>
<td>233</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>Opportunity cost of capital</td>
<td>269</td>
<td>265</td>
<td>215</td>
<td>261</td>
<td>249</td>
<td>269</td>
<td></td>
</tr>
<tr>
<td>Total non cash costs (Baht/rai)</td>
<td>436</td>
<td>421</td>
<td>408</td>
<td>534</td>
<td>482</td>
<td>338</td>
<td></td>
</tr>
<tr>
<td>Total non cash costs (Baht/ton)</td>
<td>40</td>
<td>35</td>
<td>37</td>
<td>41</td>
<td>51</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>Total cost</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Cost/rai (Bath/rai)</td>
<td>6,903</td>
<td>5,756</td>
<td>5,223</td>
<td>5,749</td>
<td>5,052</td>
<td>5,502</td>
<td></td>
</tr>
<tr>
<td>Total Cost/ton (Bath/ton)</td>
<td>628</td>
<td>523</td>
<td>475</td>
<td>442</td>
<td>532</td>
<td>447</td>
<td></td>
</tr>
<tr>
<td>Yield per rai (Tons/rai)</td>
<td>11</td>
<td>12</td>
<td>11</td>
<td>13</td>
<td>10</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Cane price (Bath/ton)</td>
<td>495</td>
<td>495</td>
<td>523</td>
<td>551</td>
<td>495</td>
<td>467</td>
<td></td>
</tr>
<tr>
<td>Total revenue (Baht/rai)</td>
<td>5,442</td>
<td>5,937</td>
<td>5,749</td>
<td>7,157</td>
<td>4,700</td>
<td>5,742</td>
<td></td>
</tr>
<tr>
<td>Accounting profit (Baht/rai)</td>
<td>-1,191</td>
<td>445</td>
<td>741</td>
<td>1,669</td>
<td>-102</td>
<td>509</td>
<td></td>
</tr>
<tr>
<td>Economic profit (Baht/rai)</td>
<td>-1,460</td>
<td>181</td>
<td>526</td>
<td>1,408</td>
<td>-352</td>
<td>240</td>
<td></td>
</tr>
</tbody>
</table>

Source: Own survey (2004)
Appendix-Table 6.2: Total cost of sugarcane farms for the first ratoon
(continue)

<table>
<thead>
<tr>
<th></th>
<th>Northeast</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NE7</td>
<td>NE8</td>
</tr>
<tr>
<td>Cash cost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Variable cost (Baht/rai)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 Labour cost (Baht/rai)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Soil Preparation</td>
<td>490</td>
<td>450</td>
</tr>
<tr>
<td>B. Soil improvement</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C. Breed preparation</td>
<td>255</td>
<td>-</td>
</tr>
<tr>
<td>D. Planting</td>
<td>150</td>
<td>238</td>
</tr>
<tr>
<td>E. Fertilizing</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>F. Chemical application</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>G. Watering</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>H. Weeding</td>
<td>360</td>
<td>120</td>
</tr>
<tr>
<td>I. Harvesting</td>
<td>1,020</td>
<td>1,113</td>
</tr>
<tr>
<td>1.2 Factor cost (Baht/rai)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Breeding cost</td>
<td>1,000</td>
<td>500</td>
</tr>
<tr>
<td>B. Fertilizer use</td>
<td>820</td>
<td>700</td>
</tr>
<tr>
<td>C. Chemical use</td>
<td>142</td>
<td>23</td>
</tr>
<tr>
<td>D. Watering cost</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>E. Fuel and lubricant cost</td>
<td>-</td>
<td>46</td>
</tr>
<tr>
<td>F. Management cost</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>G. Maintenance Cost</td>
<td>13</td>
<td>92</td>
</tr>
<tr>
<td>2. Fixed cost (Baht/rai)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land use cost</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total cash costs (Baht/rai)</td>
<td>4,375</td>
<td>3,406</td>
</tr>
<tr>
<td>Total cash costs (Baht/ton)</td>
<td>486</td>
<td>470</td>
</tr>
<tr>
<td>Non cash cost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>111</td>
<td>188</td>
</tr>
<tr>
<td>Opportunity cost of capital</td>
<td>263</td>
<td>207</td>
</tr>
<tr>
<td>Total non cash costs (Baht/rai)</td>
<td>374</td>
<td>395</td>
</tr>
<tr>
<td>Total non cash costs (Baht/ton)</td>
<td>42</td>
<td>54</td>
</tr>
<tr>
<td>Total cost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Cost/rai (Baht/rai)</td>
<td>4,749</td>
<td>3,801</td>
</tr>
<tr>
<td>Total Cost/ton (Baht/ton)</td>
<td>528</td>
<td>524</td>
</tr>
<tr>
<td>Yield per rai (Tons/rai)</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>Cane price (Baht/ton)</td>
<td>500</td>
<td>560</td>
</tr>
<tr>
<td>Total revenue (Baht/rai)</td>
<td>4,500</td>
<td>4,060</td>
</tr>
<tr>
<td>Accounting profit (Baht/rai)</td>
<td>14</td>
<td>466</td>
</tr>
<tr>
<td>Economic profit (Baht/rai)</td>
<td>-249</td>
<td>259</td>
</tr>
</tbody>
</table>

Source: Own survey (2004)
Appendix-Table 6.2: Total cost of sugarcane farms for the first ratoon (continue)

<table>
<thead>
<tr>
<th></th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cash cost</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>1. Variable cost (Baht/rai)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Soil Preparation</td>
<td>644</td>
<td>1,090</td>
<td>746</td>
<td>1,100</td>
<td>500</td>
<td>1,230</td>
</tr>
<tr>
<td>B. Soil improvement</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C. Breed preparation</td>
<td>250</td>
<td>600</td>
<td>310</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>D. Planting</td>
<td>316</td>
<td>-</td>
<td>256</td>
<td>1,200</td>
<td>600</td>
<td>650</td>
</tr>
<tr>
<td>E. Fertilizing</td>
<td>15</td>
<td>25</td>
<td>60</td>
<td>25</td>
<td>25</td>
<td>100</td>
</tr>
<tr>
<td>F. Chemical application</td>
<td>58</td>
<td>47</td>
<td>120</td>
<td>110</td>
<td>231</td>
<td>60</td>
</tr>
<tr>
<td>G. Watering</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>H. Weeding</td>
<td>260</td>
<td>384</td>
<td>320</td>
<td>240</td>
<td>200</td>
<td>160</td>
</tr>
<tr>
<td>I. Harvesting</td>
<td>1,680</td>
<td>1,350</td>
<td>1,400</td>
<td>1,500</td>
<td>1,615</td>
<td>1,126</td>
</tr>
<tr>
<td><strong>1.2 Factor cost (Baht/rai)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Breeding cost</td>
<td>650</td>
<td>471</td>
<td>638</td>
<td>881</td>
<td>600</td>
<td>1,000</td>
</tr>
<tr>
<td>B. Fertilizer use</td>
<td>860</td>
<td>1,080</td>
<td>-</td>
<td>1,000</td>
<td>520</td>
<td>1,040</td>
</tr>
<tr>
<td>C. Chemical use</td>
<td>485</td>
<td>83</td>
<td>40</td>
<td>140</td>
<td>400</td>
<td>160</td>
</tr>
<tr>
<td>D. Watering cost</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>27</td>
<td>169</td>
<td>-</td>
</tr>
<tr>
<td>E. Fuel and lubricant cost</td>
<td>96</td>
<td>-</td>
<td>1,000</td>
<td>19</td>
<td>160</td>
<td>15</td>
</tr>
<tr>
<td>F. Management cost</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>65</td>
<td>18</td>
</tr>
<tr>
<td>G. Maintenance Cost</td>
<td>0</td>
<td>10</td>
<td>-</td>
<td>-</td>
<td>42</td>
<td>-</td>
</tr>
<tr>
<td><strong>2. Fixed cost (Baht/rai)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land use cost</td>
<td>-</td>
<td>-</td>
<td>460</td>
<td>300</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total cash costs (Baht/rai)</strong></td>
<td>5,314</td>
<td>5,141</td>
<td>5,350</td>
<td>6,542</td>
<td>5,147</td>
<td>5,558</td>
</tr>
<tr>
<td><strong>Total cash costs (Baht/ton)</strong></td>
<td>443</td>
<td>343</td>
<td>535</td>
<td>436</td>
<td>303</td>
<td>556</td>
</tr>
<tr>
<td><strong>Non cash cost</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>42</td>
<td>2</td>
<td>17</td>
<td>5</td>
<td>72</td>
<td>33</td>
</tr>
<tr>
<td>Opportunity cost of capital</td>
<td>359</td>
<td>285</td>
<td>275</td>
<td>366</td>
<td>296</td>
<td>311</td>
</tr>
<tr>
<td><strong>Total non cash costs (Baht/rai)</strong></td>
<td>401</td>
<td>286</td>
<td>293</td>
<td>370</td>
<td>368</td>
<td>344</td>
</tr>
<tr>
<td><strong>Total non cash costs (Baht/ton)</strong></td>
<td>33</td>
<td>19</td>
<td>29</td>
<td>25</td>
<td>22</td>
<td>34</td>
</tr>
<tr>
<td><strong>Total cost</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Cost/rai (Baht/rai)</td>
<td>5,714</td>
<td>5,427</td>
<td>5,642</td>
<td>6,913</td>
<td>5,516</td>
<td>5,902</td>
</tr>
<tr>
<td>Total Cost/ton (Baht/ton)</td>
<td>476</td>
<td>362</td>
<td>564</td>
<td>461</td>
<td>324</td>
<td>590</td>
</tr>
<tr>
<td>Yield per rai (Tons/rai)</td>
<td>12</td>
<td>15</td>
<td>10</td>
<td>15</td>
<td>17</td>
<td>10</td>
</tr>
<tr>
<td>Cane price (Baht/ton)</td>
<td>548</td>
<td>465</td>
<td>481</td>
<td>470</td>
<td>480</td>
<td>550</td>
</tr>
<tr>
<td>Total revenue (Baht/rai)</td>
<td>6,572</td>
<td>6,975</td>
<td>4,808</td>
<td>7,050</td>
<td>8,160</td>
<td>5,500</td>
</tr>
</tbody>
</table>

**Source:** Own survey (2004)
### Appendix-Table 6.2: Total cost of sugarcane farms for the first ratoon (continue)

<table>
<thead>
<tr>
<th></th>
<th>Central</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C7</td>
<td>C8</td>
</tr>
<tr>
<td><strong>Cash cost</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Variable cost (Baht/rai)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 Labour cost (Baht/rai)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Soil Preparation</td>
<td>850</td>
<td>850</td>
</tr>
<tr>
<td>B. Soil improvement</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C. Breed preparation</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>D. Planting</td>
<td>615</td>
<td>600</td>
</tr>
<tr>
<td>E. Fertilizing</td>
<td>40</td>
<td>20</td>
</tr>
<tr>
<td>F. Chemical application</td>
<td>128</td>
<td>60</td>
</tr>
<tr>
<td>G. Watering</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>H. Weeding</td>
<td>-</td>
<td>160</td>
</tr>
<tr>
<td>I. Harvesting</td>
<td>1,260</td>
<td>1,500</td>
</tr>
<tr>
<td>1.2 Factor cost (Baht/rai)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Breeding cost</td>
<td>478</td>
<td>844</td>
</tr>
<tr>
<td>B. Fertilizer use</td>
<td>1,120</td>
<td>580</td>
</tr>
<tr>
<td>C. Chemical use</td>
<td>210</td>
<td>198</td>
</tr>
<tr>
<td>D. Watering cost</td>
<td>-</td>
<td>300</td>
</tr>
<tr>
<td>E. Fuel and lubricant cost</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>F. Management cost</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>G. Maintenance Cost</td>
<td>80</td>
<td>-</td>
</tr>
<tr>
<td>2. Fixed cost (Baht/rai)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land use cost</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total cash costs (Baht/rai)</strong></td>
<td>4,781</td>
<td>5,112</td>
</tr>
<tr>
<td><strong>Total cash costs (Baht/ton)</strong></td>
<td>531</td>
<td>341</td>
</tr>
<tr>
<td><strong>Non cash cost</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>229</td>
<td>329</td>
</tr>
<tr>
<td>Opportunity cost of capital</td>
<td>324</td>
<td>330</td>
</tr>
<tr>
<td><strong>Total non cash costs (Baht/rai)</strong></td>
<td>553</td>
<td>658</td>
</tr>
<tr>
<td><strong>Total non cash costs (Baht/ton)</strong></td>
<td>61</td>
<td>44</td>
</tr>
<tr>
<td><strong>Total cost</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Cost/rai (Baht/rai)</strong></td>
<td>5,334</td>
<td>5,770</td>
</tr>
<tr>
<td><strong>Total Cost/ton (Baht/ton)</strong></td>
<td>593</td>
<td>385</td>
</tr>
<tr>
<td>Yield per rai (Tons/rai)</td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td>Cane price (Baht/ton)</td>
<td>475</td>
<td>450</td>
</tr>
<tr>
<td><strong>Total revenue (Baht/rai)</strong></td>
<td>4,275</td>
<td>6,750</td>
</tr>
<tr>
<td><strong>Accounting profit (Baht/rai)</strong></td>
<td>-735</td>
<td>1,310</td>
</tr>
<tr>
<td><strong>Economic profit (Baht/rai)</strong></td>
<td>-1,059</td>
<td>980</td>
</tr>
</tbody>
</table>

**Source:** Own survey (2004)
## Appendix-Table 6.3: Total cost of sugarcane farms for the second ratoon

<table>
<thead>
<tr>
<th></th>
<th>N1</th>
<th>N2</th>
<th>N3</th>
<th>N4</th>
<th>N5</th>
<th>N6</th>
<th>N7</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cash cost</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>1. Variable cost (Baht/rai)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>1.1 Labour cost</strong></td>
<td>(Baht/rai)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Soil Preparation</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>B. Soil improvement</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>C. Breed preparation</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>D. Planting</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>E. Fertilizing</td>
<td>210</td>
<td>200</td>
<td>20</td>
<td>60</td>
<td>130</td>
<td>130</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>F. Chemical application</td>
<td>100</td>
<td>120</td>
<td>40</td>
<td>70</td>
<td>-</td>
<td>-</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>G. Watering</td>
<td>16</td>
<td>-</td>
<td>8</td>
<td>83</td>
<td>-</td>
<td>-</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>H. Weeding</td>
<td>130</td>
<td>480</td>
<td>-</td>
<td>248</td>
<td>-</td>
<td>-</td>
<td>132</td>
<td></td>
</tr>
<tr>
<td>I. Harvesting</td>
<td>1,105</td>
<td>1,300</td>
<td>1,100</td>
<td>1,687</td>
<td>1,200</td>
<td>1,320</td>
<td>1,380</td>
<td></td>
</tr>
<tr>
<td><strong>1.2 Factor cost (Baht/rai)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Breeding cost</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>900</td>
<td></td>
</tr>
<tr>
<td>B. Fertilizer use</td>
<td>676</td>
<td>743</td>
<td>743</td>
<td>375</td>
<td>850</td>
<td>818</td>
<td>818</td>
<td></td>
</tr>
<tr>
<td>C. Chemical use</td>
<td>170</td>
<td>296</td>
<td>175</td>
<td>166</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>D. Watering cost</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>E. Fuel and lubricant cost</td>
<td>45</td>
<td>47</td>
<td>25</td>
<td>57</td>
<td>284</td>
<td>86</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>F. Management cost</td>
<td>19</td>
<td>10</td>
<td>12</td>
<td>10</td>
<td>25</td>
<td>17</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>G. Maintenance Cost</td>
<td>8</td>
<td>14</td>
<td>26</td>
<td>75</td>
<td>13</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td><strong>2. Fixed cost (Baht/rai)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land use cost</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>800</td>
<td>800</td>
<td>800</td>
<td></td>
</tr>
<tr>
<td><strong>Total cash costs (Baht/rai)</strong></td>
<td>2,480</td>
<td>3,210</td>
<td>2,150</td>
<td>2,931</td>
<td>3,303</td>
<td>3,171</td>
<td>4,073</td>
<td>3,093</td>
</tr>
<tr>
<td><strong>Total cash costs (Baht/ton)</strong></td>
<td>292</td>
<td>321</td>
<td>215</td>
<td>266</td>
<td>254</td>
<td>288</td>
<td>441</td>
<td>297</td>
</tr>
<tr>
<td><strong>Non cash cost</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>42</td>
<td>4</td>
<td>42</td>
<td>88</td>
<td>175</td>
<td>109</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>Opportunity cost of capital</td>
<td>160</td>
<td>155</td>
<td>119</td>
<td>181</td>
<td>154</td>
<td>105</td>
<td>175</td>
<td></td>
</tr>
<tr>
<td><strong>Total non cash costs (Baht/rai)</strong></td>
<td>202</td>
<td>160</td>
<td>161</td>
<td>269</td>
<td>329</td>
<td>215</td>
<td>296</td>
<td>233</td>
</tr>
<tr>
<td><strong>Total non cash costs (Baht/ton)</strong></td>
<td>24</td>
<td>16</td>
<td>16</td>
<td>24</td>
<td>25</td>
<td>20</td>
<td>30</td>
<td>22</td>
</tr>
<tr>
<td><strong>Total cost</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Cost/rai (Bath/rai)</strong></td>
<td>2,682</td>
<td>3,370</td>
<td>2,311</td>
<td>3,200</td>
<td>3,632</td>
<td>3,386</td>
<td>4,703</td>
<td>3,326</td>
</tr>
<tr>
<td><strong>Total Cost/ton (Bath/ton)</strong></td>
<td>316</td>
<td>288</td>
<td>231</td>
<td>291</td>
<td>303</td>
<td>308</td>
<td>470</td>
<td>315</td>
</tr>
<tr>
<td>Yield per rai (Tons/rai)</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>13</td>
<td>11</td>
<td>10</td>
<td>10.5</td>
<td>10.5</td>
</tr>
<tr>
<td>Cane price (Baht/ton)</td>
<td>520</td>
<td>489</td>
<td>460</td>
<td>467</td>
<td>455</td>
<td>450</td>
<td>592</td>
<td>490.4</td>
</tr>
<tr>
<td>Total revenue (Baht/rai)</td>
<td>4,420</td>
<td>4,892</td>
<td>4,599</td>
<td>5,135</td>
<td>5,915</td>
<td>4,950</td>
<td>5,916</td>
<td>5,118</td>
</tr>
<tr>
<td>Accounting profit (Baht/rai)</td>
<td>1,898</td>
<td>1,677</td>
<td>2,406</td>
<td>2,117</td>
<td>2,437</td>
<td>1,669</td>
<td>1,338</td>
<td>1,942</td>
</tr>
<tr>
<td>Economic profit (Baht/rai)</td>
<td>1,738</td>
<td>1,522</td>
<td>2,288</td>
<td>1,936</td>
<td>2,283</td>
<td>1,564</td>
<td>1,213</td>
<td>1,792</td>
</tr>
</tbody>
</table>

**Source:** Own survey (2004)
Appendix-Table 6.3: Total cost of sugarcane farms for the second ratoon (continue)

<table>
<thead>
<tr>
<th>Cash cost</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NE1</td>
<td>NE2</td>
<td>NE3</td>
<td>NE4</td>
<td>NE5</td>
<td>NE6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Variable cost (Baht/rai)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 Labour cost (Baht/rai)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Soil Preparation</td>
<td>116</td>
<td>-</td>
<td>-</td>
<td>240</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>B. Soil improvement</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C. Breed preparation</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>D. Planting</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>E. Fertilizing</td>
<td>40</td>
<td>41</td>
<td>-</td>
<td>40</td>
<td>35</td>
<td>25</td>
</tr>
<tr>
<td>F. Chemical application</td>
<td>300</td>
<td>80</td>
<td>-</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>G. Watering</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>H. Weeding</td>
<td>300</td>
<td>696</td>
<td>-</td>
<td>-</td>
<td>320</td>
<td>390</td>
</tr>
<tr>
<td>I. Harvesting</td>
<td>1,210</td>
<td>1,314</td>
<td>-</td>
<td>1,365</td>
<td>1,087</td>
<td>1,100</td>
</tr>
<tr>
<td>1.2 Factor cost (Baht/rai)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Breeding cost</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>B. Fertilizer use</td>
<td>890</td>
<td>1,335</td>
<td>-</td>
<td>950</td>
<td>445</td>
<td>1,100</td>
</tr>
<tr>
<td>C. Chemical use</td>
<td>-</td>
<td>230</td>
<td>-</td>
<td>210</td>
<td>75</td>
<td>94</td>
</tr>
<tr>
<td>D. Watering cost</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>E. Fuel and lubricant cost</td>
<td>24</td>
<td>133</td>
<td>-</td>
<td>165</td>
<td>23</td>
<td>24</td>
</tr>
<tr>
<td>F. Management cost</td>
<td>58</td>
<td>137</td>
<td>-</td>
<td>25</td>
<td>33</td>
<td>10</td>
</tr>
<tr>
<td>G. Maintenance Cost</td>
<td>64</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>69</td>
<td>62</td>
</tr>
<tr>
<td>2. Fixed cost (Baht/rai)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land use cost</td>
<td>-</td>
<td>450</td>
<td>-</td>
<td>-</td>
<td>700</td>
<td>-</td>
</tr>
<tr>
<td>Total cash costs (Baht/rai)</td>
<td>3,002</td>
<td>4,416</td>
<td>-</td>
<td>3,095</td>
<td>2,885</td>
<td>2,904</td>
</tr>
<tr>
<td>Total cash costs (Baht/ton)</td>
<td>273</td>
<td>491</td>
<td>-</td>
<td>238</td>
<td>412</td>
<td>342</td>
</tr>
<tr>
<td>Non cash cost</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>169</td>
<td>63</td>
<td>-</td>
<td>273</td>
<td>116</td>
<td>174</td>
</tr>
<tr>
<td>Opportunity cost of capital</td>
<td>118</td>
<td>133</td>
<td>-</td>
<td>122</td>
<td>111</td>
<td>146</td>
</tr>
<tr>
<td>Total non cash costs (Baht/rai)</td>
<td>287</td>
<td>196</td>
<td>-</td>
<td>395</td>
<td>227</td>
<td>320</td>
</tr>
<tr>
<td>Total non cash costs (Baht/ton)</td>
<td>26</td>
<td>22</td>
<td>-</td>
<td>30</td>
<td>32</td>
<td>38</td>
</tr>
<tr>
<td>Total cost</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Cost/rai (Bath/rai)</td>
<td>3,288</td>
<td>4,613</td>
<td>-</td>
<td>3,490</td>
<td>3,113</td>
<td>3,224</td>
</tr>
<tr>
<td>Total Cost/ton (Bath/ton)</td>
<td>299</td>
<td>419</td>
<td>-</td>
<td>268</td>
<td>328</td>
<td>262</td>
</tr>
<tr>
<td>Yield per rai (Tons/rai)</td>
<td>11</td>
<td>9</td>
<td>-</td>
<td>13</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Cane price (Baht/ton)</td>
<td>495</td>
<td>495</td>
<td>-</td>
<td>551</td>
<td>495</td>
<td>467</td>
</tr>
<tr>
<td>Total revenue (Baht/rai)</td>
<td>5,442</td>
<td>4,453</td>
<td>-</td>
<td>7,157</td>
<td>3,463</td>
<td>3,968</td>
</tr>
<tr>
<td>Accounting profit (Baht/rai)</td>
<td>2,272</td>
<td>-26</td>
<td>-</td>
<td>3,789</td>
<td>462</td>
<td>890</td>
</tr>
<tr>
<td>Economic profit (Baht/rai)</td>
<td>2,154</td>
<td>-160</td>
<td>-</td>
<td>3,668</td>
<td>351</td>
<td>744</td>
</tr>
</tbody>
</table>

Source: Own survey (2004)
Appendix-Table 6.3: Total cost of sugarcane farms for the second ratoon (continue)

<table>
<thead>
<tr>
<th></th>
<th>Northeast</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NE7</td>
<td>NE8</td>
</tr>
<tr>
<td><strong>Cash cost</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Variable cost (Baht/rai)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 Labour cost (Baht/rai)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Soil Preparation</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>B. Soil improvement</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C. Breed preparation</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>D. Planting</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>E. Fertilizing</td>
<td>-</td>
<td>25</td>
</tr>
<tr>
<td>F. Chemical application</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>G. Watering</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>H. Weeding</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>I. Harvesting</td>
<td>-</td>
<td>1,108</td>
</tr>
<tr>
<td>1.2 Factor cost (Baht/rai)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Breeding cost</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>B. Fertilizer use</td>
<td>-</td>
<td>350</td>
</tr>
<tr>
<td>C. Chemical use</td>
<td>-</td>
<td>30</td>
</tr>
<tr>
<td>D. Watering cost</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>E. Fuel and lubricant cost</td>
<td>-</td>
<td>46</td>
</tr>
<tr>
<td>F. Management cost</td>
<td>-</td>
<td>10</td>
</tr>
<tr>
<td>G. Maintenance Cost</td>
<td>-</td>
<td>62</td>
</tr>
<tr>
<td>2. Fixed cost (Baht/rai)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land use cost</td>
<td>-</td>
<td>300</td>
</tr>
<tr>
<td><strong>Total cash costs (Baht/rai)</strong></td>
<td>-</td>
<td>2,030</td>
</tr>
<tr>
<td><strong>Total cash costs (Baht/ton)</strong></td>
<td>-</td>
<td>274</td>
</tr>
<tr>
<td><strong>Non cash cost</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>-</td>
<td>125</td>
</tr>
<tr>
<td>Opportunity cost of capital</td>
<td>-</td>
<td>112</td>
</tr>
<tr>
<td><strong>Total non cash costs (Baht/rai)</strong></td>
<td>-</td>
<td>237</td>
</tr>
<tr>
<td><strong>Total non cash costs (Baht/ton)</strong></td>
<td>-</td>
<td>32</td>
</tr>
<tr>
<td><strong>Total cost</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Cost/rai (Bath/rai)</strong></td>
<td>-</td>
<td>2,268</td>
</tr>
<tr>
<td><strong>Total Cost/ton (Bath/ton)</strong></td>
<td>-</td>
<td>313</td>
</tr>
<tr>
<td>Yield per rai (Tons/rai)</td>
<td>-</td>
<td>7</td>
</tr>
<tr>
<td>Cane price (Baht/ton)</td>
<td>-</td>
<td>560</td>
</tr>
<tr>
<td>Total revenue (Baht/rai)</td>
<td>-</td>
<td>4,144</td>
</tr>
<tr>
<td>Accounting profit (Baht/rai)</td>
<td>-</td>
<td>1,988</td>
</tr>
<tr>
<td>Economic profit (Baht/rai)</td>
<td>-</td>
<td>1,876</td>
</tr>
</tbody>
</table>

**Source:** Own survey (2004)
## Appendix-Table 6.3: Total cost of sugarcane farms for the second ratoon (continue)

<table>
<thead>
<tr>
<th>Cash cost</th>
<th>Central</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C1</td>
<td>C2</td>
<td>C3</td>
<td>C4</td>
<td>C5</td>
<td>C6</td>
</tr>
<tr>
<td><strong>Variable cost (Baht/rai)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>1. Labour cost (Baht/rai)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Soil Preparation</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>B. Soil improvement</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C. Breed preparation</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>D. Planting</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>E. Fertilizing</td>
<td>15</td>
<td>7</td>
<td>50</td>
<td>50</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>F. Chemical application</td>
<td>58</td>
<td>-</td>
<td>48</td>
<td>220</td>
<td>237</td>
<td>120</td>
</tr>
<tr>
<td>G. Watering</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>27</td>
<td>-</td>
</tr>
<tr>
<td>H. Weeding</td>
<td>260</td>
<td>100</td>
<td>-</td>
<td>-</td>
<td>170</td>
<td>-</td>
</tr>
<tr>
<td>I. Harvesting</td>
<td>1,092</td>
<td>1,716</td>
<td>1,400</td>
<td>1,500</td>
<td>1,425</td>
<td>1,126</td>
</tr>
<tr>
<td><strong>1.2 Factor cost (Baht/rai)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Breeding cost</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>B. Fertilizer use</td>
<td>860</td>
<td>114</td>
<td>500</td>
<td>1,000</td>
<td>462</td>
<td>1,040</td>
</tr>
<tr>
<td>C. Chemical use</td>
<td>460</td>
<td>-</td>
<td>240</td>
<td>140</td>
<td>269</td>
<td>160</td>
</tr>
<tr>
<td>D. Watering</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>54</td>
<td>115</td>
<td>-</td>
</tr>
<tr>
<td>E. Fuel and lubricant cost</td>
<td>96</td>
<td>-</td>
<td>50</td>
<td>19</td>
<td>77</td>
<td>-</td>
</tr>
<tr>
<td>F. Management cost</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>78</td>
<td>28</td>
</tr>
<tr>
<td>G. Maintenance Cost</td>
<td>0</td>
<td>144</td>
<td>-</td>
<td>-</td>
<td>116</td>
<td>-</td>
</tr>
<tr>
<td><strong>2. Fixed cost (Baht/rai)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land use cost</td>
<td>460</td>
<td>400</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total cash costs (Baht/rai)</strong></td>
<td>3,301</td>
<td>2,481</td>
<td>2,688</td>
<td>2,993</td>
<td>3,002</td>
<td>2,524</td>
</tr>
<tr>
<td><strong>Total cash costs (Baht/ton)</strong></td>
<td>314</td>
<td>187</td>
<td>269</td>
<td>200</td>
<td>200</td>
<td>252</td>
</tr>
<tr>
<td><strong>Non cash cost</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>421</td>
<td>24</td>
<td>39</td>
<td>9</td>
<td>201</td>
<td>65</td>
</tr>
<tr>
<td>Opportunity cost of capital</td>
<td>182</td>
<td>138</td>
<td>128</td>
<td>138</td>
<td>155</td>
<td>105</td>
</tr>
<tr>
<td><strong>Total non cash costs (Baht/rai)</strong></td>
<td>603</td>
<td>162</td>
<td>167</td>
<td>148</td>
<td>356</td>
<td>171</td>
</tr>
<tr>
<td><strong>Total non cash costs (Baht/ton)</strong></td>
<td>57</td>
<td>12</td>
<td>17</td>
<td>10</td>
<td>24</td>
<td>17</td>
</tr>
<tr>
<td><strong>Total cost</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Cost/rai (Bath/rai)</strong></td>
<td>3,904</td>
<td>2,643</td>
<td>2,855</td>
<td>3,141</td>
<td>3,358</td>
<td>2,694</td>
</tr>
<tr>
<td><strong>Total Cost/ton (Bath/ton)</strong></td>
<td>325</td>
<td>176</td>
<td>286</td>
<td>209</td>
<td>198</td>
<td>269</td>
</tr>
<tr>
<td>Yield per rai (Tons/rai)</td>
<td>11</td>
<td>13</td>
<td>10</td>
<td>15</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>Cane price (Baht/ton)</td>
<td>548</td>
<td>465</td>
<td>481</td>
<td>470</td>
<td>584</td>
<td>425</td>
</tr>
<tr>
<td><strong>Total revenue (Baht/rai)</strong></td>
<td>5,751</td>
<td>6,156</td>
<td>4,808</td>
<td>7,050</td>
<td>8,763</td>
<td>4,250</td>
</tr>
<tr>
<td><strong>Accounting profit (Baht/rai)</strong></td>
<td>2,029</td>
<td>3,651</td>
<td>2,081</td>
<td>4,047</td>
<td>5,560</td>
<td>1,661</td>
</tr>
<tr>
<td><strong>Economic profit (Baht/rai)</strong></td>
<td>1,847</td>
<td>3,512</td>
<td>1,953</td>
<td>3,909</td>
<td>5,405</td>
<td>1,556</td>
</tr>
</tbody>
</table>

**Source:** Own survey (2004)
### Appendix-Table 6.3: Total cost of sugarcane farms for the second ratoon (continue)

<table>
<thead>
<tr>
<th></th>
<th>C7</th>
<th>C8</th>
<th>C9</th>
<th>C10</th>
<th>C11</th>
<th>C12</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cash cost</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Variable cost (Baht/rai)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 Labour cost (Baht/rai)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Soil Preparation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Soil improvement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. Breed preparation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. Planting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. Fertilizing</td>
<td>40</td>
<td>-</td>
<td>120</td>
<td>20</td>
<td>33</td>
<td>-</td>
</tr>
<tr>
<td>F. Chemical application</td>
<td>64</td>
<td>-</td>
<td>180</td>
<td>53</td>
<td>200</td>
<td>-</td>
</tr>
<tr>
<td>G. Watering</td>
<td>-</td>
<td>-</td>
<td>120</td>
<td>120</td>
<td>67</td>
<td>-</td>
</tr>
<tr>
<td>H. Weeding</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>144</td>
<td>122</td>
<td>-</td>
</tr>
<tr>
<td>I. Harvesting</td>
<td>1,260</td>
<td>-</td>
<td>1,700</td>
<td>1,470</td>
<td>1,300</td>
<td>-</td>
</tr>
<tr>
<td>1.2 Factor cost (Baht/rai)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Breeding cost</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Fertilizer use</td>
<td>1,120</td>
<td>-</td>
<td>1,120</td>
<td>1,000</td>
<td>600</td>
<td>-</td>
</tr>
<tr>
<td>C. Chemical use</td>
<td>70</td>
<td>-</td>
<td>210</td>
<td>107</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>D. Watering cost</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>E. Fuel and lubricant cost</td>
<td>-</td>
<td>-</td>
<td>360</td>
<td>120</td>
<td>210</td>
<td>-</td>
</tr>
<tr>
<td>F. Management cost</td>
<td>10</td>
<td>-</td>
<td>30</td>
<td>19</td>
<td>196</td>
<td>-</td>
</tr>
<tr>
<td>G. Maintenance Cost</td>
<td>20</td>
<td>-</td>
<td>10</td>
<td>-</td>
<td>25</td>
<td>-</td>
</tr>
<tr>
<td>2. Fixed cost (Baht/rai)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land use cost</td>
<td>-</td>
<td>-</td>
<td>1,000</td>
<td></td>
<td>1,500</td>
<td>-</td>
</tr>
<tr>
<td>Total cash costs (Baht/rai)</td>
<td>2,584</td>
<td>-</td>
<td>4,640</td>
<td>4,656</td>
<td>2,860</td>
<td>-</td>
</tr>
<tr>
<td>Total cash costs (Baht/ton)</td>
<td>287</td>
<td>-</td>
<td>464</td>
<td>333</td>
<td>220</td>
<td>-</td>
</tr>
<tr>
<td><strong>Non cash cost</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>57</td>
<td>-</td>
<td>60</td>
<td>354</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>Opportunity cost of capital</td>
<td>173</td>
<td>-</td>
<td>98</td>
<td>205</td>
<td>172</td>
<td>-</td>
</tr>
<tr>
<td>Total non cash costs (Baht/rai)</td>
<td>230</td>
<td>-</td>
<td>158</td>
<td>559</td>
<td>193</td>
<td>-</td>
</tr>
<tr>
<td>Total non cash costs (Baht/ton)</td>
<td>26</td>
<td>-</td>
<td>16</td>
<td>40</td>
<td>15</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total cost</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Cost/rai (Bath/rai)</td>
<td>2,814</td>
<td>-</td>
<td>4,798</td>
<td>5,214</td>
<td>3,053</td>
<td>-</td>
</tr>
<tr>
<td>Total Cost/ton (Bath/ton)</td>
<td>313</td>
<td>-</td>
<td>348</td>
<td>235</td>
<td>-</td>
<td>236</td>
</tr>
<tr>
<td>Yield per rai (Tons/rai)</td>
<td>9</td>
<td>10</td>
<td>14</td>
<td>13</td>
<td>-</td>
<td>12.0</td>
</tr>
<tr>
<td>Cane price (Baht/ton)</td>
<td>475</td>
<td>-</td>
<td>480</td>
<td>600</td>
<td>519</td>
<td>-</td>
</tr>
<tr>
<td>Total revenue (Baht/rai)</td>
<td>4,275</td>
<td>-</td>
<td>4,800</td>
<td>8,400</td>
<td>6,747</td>
<td>-</td>
</tr>
<tr>
<td>Accounting profit (Baht/rai)</td>
<td>1,634</td>
<td>-</td>
<td>100</td>
<td>3,391</td>
<td>3,867</td>
<td>-</td>
</tr>
<tr>
<td>Economic profit (Baht/rai)</td>
<td>1,461</td>
<td>-</td>
<td>2</td>
<td>3,186</td>
<td>3,694</td>
<td>-</td>
</tr>
<tr>
<td>Source: Own survey (2004)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Appendix-Table 6.4: Total cost of sugarcane farms for the third ratoon

<table>
<thead>
<tr>
<th></th>
<th>North</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N1</td>
<td>N2</td>
</tr>
<tr>
<td><strong>Cash cost</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Variable cost (Baht/rai)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 Labour cost (Baht/rai)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Soil Preparation</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>B. Soil improvement</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C. Breed preparation</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>D. Planting</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>E. Fertilizing</td>
<td>210</td>
<td>27</td>
</tr>
<tr>
<td>F. Chemical application</td>
<td>100</td>
<td>44</td>
</tr>
<tr>
<td>G. Watering</td>
<td>16</td>
<td>-</td>
</tr>
<tr>
<td>H. Weeding</td>
<td>130</td>
<td>-</td>
</tr>
<tr>
<td>I. Harvesting</td>
<td>1,105</td>
<td>1,100</td>
</tr>
<tr>
<td>1.2 Factor cost (Baht/rai)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Breeding cost</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>B. Fertilizer use</td>
<td>676</td>
<td>743</td>
</tr>
<tr>
<td>C. Chemical use</td>
<td>170</td>
<td>84</td>
</tr>
<tr>
<td>D. Watering cost</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>E. Fuel and lubricant cost</td>
<td>45</td>
<td>148</td>
</tr>
<tr>
<td>F. Management cost</td>
<td>18</td>
<td>14</td>
</tr>
<tr>
<td>G. Maintenance Cost</td>
<td>5</td>
<td>79</td>
</tr>
<tr>
<td>2. Fixed cost (Baht/rai)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total cash costs (Baht/rai)</td>
<td>2,476</td>
<td>2,240</td>
</tr>
<tr>
<td>Total cash costs (Baht/ton)</td>
<td>310</td>
<td>224</td>
</tr>
<tr>
<td><strong>Non cash cost</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>28</td>
<td>-</td>
</tr>
<tr>
<td>Opportunity cost of capital</td>
<td>160</td>
<td>-</td>
</tr>
<tr>
<td>Total non cash costs (Baht/rai)</td>
<td>188</td>
<td>242</td>
</tr>
<tr>
<td>Total non cash costs (Baht/ton)</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td><strong>Total cost</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Cost/rai (Bath/rai)</td>
<td>2,664</td>
<td>2,482</td>
</tr>
<tr>
<td>Total Cost/ton (Bath/ton)</td>
<td>333</td>
<td>248</td>
</tr>
<tr>
<td>Yield per Rai</td>
<td>8</td>
<td>-</td>
</tr>
<tr>
<td>Cane price (Baht/ton)</td>
<td>520</td>
<td>460</td>
</tr>
<tr>
<td>Total revenue (Baht/rai)</td>
<td>4,160</td>
<td>4,599</td>
</tr>
<tr>
<td>Accounting profit (Baht/rai)</td>
<td>1,656</td>
<td>2,232</td>
</tr>
<tr>
<td>Economic profit (Baht/rai)</td>
<td>1,496</td>
<td>2,117</td>
</tr>
</tbody>
</table>

**Source:** Own survey (2004)
### Appendix-Table 6.4: Total cost of sugarcane farms for the third ratoon (continue)

<table>
<thead>
<tr>
<th></th>
<th>Central</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C1   C2  C3  C4   C5   C6   C7</td>
</tr>
<tr>
<td><strong>Cash cost</strong></td>
<td></td>
</tr>
<tr>
<td><strong>1. Variable cost (Baht/rai)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>1.1 Labour cost (Baht/rai)</strong></td>
<td></td>
</tr>
<tr>
<td>A. Soil Preparation</td>
<td>-    -    -    -    -    -    -</td>
</tr>
<tr>
<td>B. Soil improvement</td>
<td>-    -    -    -    -    -    -</td>
</tr>
<tr>
<td>C. Breed preparation</td>
<td>-    -    -    -    -    -    -</td>
</tr>
<tr>
<td>D. Planting</td>
<td>-    -    -    -    -    -    -</td>
</tr>
<tr>
<td>E. Fertilizing</td>
<td>30   -    -    50   25   100  40</td>
</tr>
<tr>
<td>F. Chemical application</td>
<td>-    -    -    220  220  60   128</td>
</tr>
<tr>
<td>G. Watering</td>
<td>-    -    -    -    55   -    -</td>
</tr>
<tr>
<td>H. Weeding</td>
<td>60   -    -    -    -    160  -</td>
</tr>
<tr>
<td>I. Harvesting</td>
<td>980  -    -    1,400 1,425 1,132 1,260</td>
</tr>
<tr>
<td><strong>1.2 Factor cost (Baht/rai)</strong></td>
<td></td>
</tr>
<tr>
<td>A. Breeding cost</td>
<td>-    -    -    -    -    -    -</td>
</tr>
<tr>
<td>B. Fertilizer use</td>
<td>430  -    -    1,000 520  1,040 1,120</td>
</tr>
<tr>
<td>C. Chemical use</td>
<td>-    -    -    117   250  160   210</td>
</tr>
<tr>
<td>D. Watering cost</td>
<td>-    -    -    27    125  -    -</td>
</tr>
<tr>
<td>E. Fuel and lubricant cost</td>
<td>96   -    -    19    125  15   -</td>
</tr>
<tr>
<td>F. Management cost</td>
<td>10   -    -    10    78   18   -</td>
</tr>
<tr>
<td>G. Maintenance Cost</td>
<td>0    -    -    -    33   -    20</td>
</tr>
<tr>
<td><strong>2. Fixed cost (Baht/rai)</strong></td>
<td></td>
</tr>
<tr>
<td>Land use cost</td>
<td>460  -    -    -    -    -    -</td>
</tr>
<tr>
<td><strong>Total cash costs (Baht/rai)</strong></td>
<td>2,066  -    -    2,843 2,855 2,684 2,778</td>
</tr>
<tr>
<td><strong>Total cash costs (Baht/ton)</strong></td>
<td>295   -    -    203   190  268  309</td>
</tr>
<tr>
<td><strong>Non cash cost</strong></td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>337  -    -    14    56   65   57</td>
</tr>
<tr>
<td>Opportunity cost of capital</td>
<td>106  -    -    129  143  114  190</td>
</tr>
<tr>
<td><strong>Total non cash costs (Baht/rai)</strong></td>
<td>443   -    -    143  199  179  248</td>
</tr>
<tr>
<td><strong>Total non cash costs (Baht/ton)</strong></td>
<td>63    -    -    10    13   18   28</td>
</tr>
<tr>
<td><strong>Total cost</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Total Cost/rai (Bath/rai)</strong></td>
<td>2,509  -    -    2,986 3,054 2,863 3,026</td>
</tr>
<tr>
<td><strong>Total Cost/ton (Bath/ton)</strong></td>
<td>209    -    -    199  180  286  336</td>
</tr>
<tr>
<td>Yield per rai</td>
<td>7    -    -    14    15   10   9</td>
</tr>
<tr>
<td>Cane price (Baht/ton)</td>
<td>548   -    -    470  584  425  475</td>
</tr>
<tr>
<td>Total revenue (Baht/rai)</td>
<td>3,834  -    -    6,580 8,763 4,250 4,275</td>
</tr>
<tr>
<td>Accounting profit (Baht/rai)</td>
<td>1,431  -    -    3,723 5,851 1,501 1,440</td>
</tr>
<tr>
<td>Economic profit (Baht/rai)</td>
<td>1,325  -    -    3,594 5,708 1,387 1,249</td>
</tr>
</tbody>
</table>

**Source:** Own survey (2004)
Appendix-Table 6.4: Total cost of sugarcane farms for the third ratoon (continue)

<table>
<thead>
<tr>
<th></th>
<th>Central</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C8</td>
<td>C9</td>
</tr>
<tr>
<td><strong>Cash cost</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Variable cost (Baht/rai)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 Labour cost (Baht/rai)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Soil Preparation</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>B. Soil improvement</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C. Breed preparation</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>D. Planting</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>E. Fertilizing</td>
<td>-</td>
<td>120</td>
</tr>
<tr>
<td>F. Chemical application</td>
<td>-</td>
<td>180</td>
</tr>
<tr>
<td>G. Watering</td>
<td>-</td>
<td>120</td>
</tr>
<tr>
<td>H. Weeding</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>I. Harvesting</td>
<td>-</td>
<td>1,200</td>
</tr>
<tr>
<td>1.2 Factor cost (Baht/rai)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Breeding cost</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>B. Fertilizer use</td>
<td>-</td>
<td>1,120</td>
</tr>
<tr>
<td>C. Chemical use</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>D. Watering cost</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>E. Fuel and lubricant cost</td>
<td>-</td>
<td>360</td>
</tr>
<tr>
<td>F. Management cost</td>
<td>-</td>
<td>30</td>
</tr>
<tr>
<td>G. Maintenance Cost</td>
<td>-</td>
<td>48</td>
</tr>
<tr>
<td>2. Fixed cost (Baht/rai)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land use cost</td>
<td>-</td>
<td>1,000</td>
</tr>
<tr>
<td><strong>Total cash costs (Baht/rai)</strong></td>
<td>-</td>
<td>4,179</td>
</tr>
<tr>
<td><strong>Total cash costs (Baht/ton)</strong></td>
<td>-</td>
<td>522</td>
</tr>
<tr>
<td><strong>Non cash cost</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>-</td>
<td>298</td>
</tr>
<tr>
<td>Opportunity cost of capital</td>
<td>-</td>
<td>188</td>
</tr>
<tr>
<td><strong>Total non cash costs (Baht/rai)</strong></td>
<td>-</td>
<td>486</td>
</tr>
<tr>
<td><strong>Total non cash costs (Baht/ton)</strong></td>
<td>-</td>
<td>61</td>
</tr>
<tr>
<td><strong>Total cost</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Cost/rai (Bath/rai)</td>
<td>-</td>
<td>4,665</td>
</tr>
<tr>
<td>Total Cost/ton (Bath/ton)</td>
<td>-</td>
<td>583</td>
</tr>
<tr>
<td><strong>Yield per Rai</strong></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td><strong>Cane price (Baht/ton)</strong></td>
<td>-</td>
<td>480</td>
</tr>
<tr>
<td><strong>Total revenue (Baht/rai)</strong></td>
<td>-</td>
<td>3,840</td>
</tr>
<tr>
<td><strong>Accounting profit (Baht/rai)</strong></td>
<td>-</td>
<td>-637</td>
</tr>
<tr>
<td><strong>Economic profit (Baht/rai)</strong></td>
<td>-</td>
<td>-825</td>
</tr>
</tbody>
</table>

**Source:** Own survey (2004)
Appendix-Table 6.5: Summary of the average total cost of sugarcane production classified by regions

<table>
<thead>
<tr>
<th>Region</th>
<th>Total cost of sugarcane production</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>First ratoon</td>
<td>Second ratoon</td>
</tr>
<tr>
<td>North (Euro/ha)</td>
<td>664</td>
<td>416</td>
</tr>
<tr>
<td>Northeast (Euro/ha)</td>
<td>639</td>
<td>394</td>
</tr>
<tr>
<td>Central (Euro/ha)</td>
<td>715</td>
<td>431</td>
</tr>
<tr>
<td>Average (Euro/ha)</td>
<td>673</td>
<td>413</td>
</tr>
</tbody>
</table>


Appendix-Table 6.6: Average sugar cane yield and price received of farm classified by regions in Thailand in the production year 2004/2005

<table>
<thead>
<tr>
<th>Region</th>
<th>Unit</th>
<th>Ratoon</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Average yield (Tons/ha)</td>
<td>North</td>
<td>67.4</td>
<td>65.6</td>
</tr>
<tr>
<td>Average price (Euro/ton)</td>
<td>North</td>
<td>9.5</td>
<td>9.8</td>
</tr>
<tr>
<td>Northeast</td>
<td>65.1</td>
<td>58.8</td>
<td>-</td>
</tr>
<tr>
<td>Central</td>
<td>80.5</td>
<td>74.8</td>
<td>69.6</td>
</tr>
<tr>
<td>Average</td>
<td>71.0</td>
<td>66.4</td>
<td>64.5</td>
</tr>
<tr>
<td>North</td>
<td>9.5</td>
<td>9.8</td>
<td>9.5</td>
</tr>
<tr>
<td>Northeast</td>
<td>10.1</td>
<td>10.2</td>
<td>-</td>
</tr>
<tr>
<td>Central</td>
<td>10.0</td>
<td>10.1</td>
<td>10.3</td>
</tr>
<tr>
<td>Average</td>
<td>9.8</td>
<td>10.0</td>
<td>9.9</td>
</tr>
</tbody>
</table>


Appendix-Table 6.7: Comparison of the total revenue of sugarcane production classified by regions

<table>
<thead>
<tr>
<th>Region</th>
<th>Unit</th>
<th>Total revenue of sugarcane production</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unit</td>
<td>First ratoon</td>
<td>Second ratoon</td>
</tr>
<tr>
<td>North</td>
<td>(Euro/ha)</td>
<td>636</td>
<td>640</td>
</tr>
<tr>
<td>Northeast</td>
<td>(Euro/ha)</td>
<td>655</td>
<td>601</td>
</tr>
<tr>
<td>Central</td>
<td>(Euro/ha)</td>
<td>805</td>
<td>763</td>
</tr>
<tr>
<td>Average</td>
<td>(Euro/ha)</td>
<td>699</td>
<td>668</td>
</tr>
</tbody>
</table>

### Appendix-Table 6.8: Profit of sugarcane farms classified by ratoon and regions

<table>
<thead>
<tr>
<th>Ratoon</th>
<th>Unit</th>
<th>Region</th>
<th>North</th>
<th>Northeast</th>
<th>Central</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total revenue</td>
<td>1st</td>
<td>(Euro/ha)</td>
<td>636</td>
<td>655</td>
<td>805</td>
<td>699</td>
</tr>
<tr>
<td></td>
<td>2nd</td>
<td>(Euro/ha)</td>
<td>640</td>
<td>601</td>
<td>763</td>
<td>668</td>
</tr>
<tr>
<td></td>
<td>3rd</td>
<td>(Euro/ha)</td>
<td>560</td>
<td>0</td>
<td>721</td>
<td>641</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>(Euro/ha)</td>
<td>612</td>
<td>628</td>
<td>763</td>
<td></td>
</tr>
<tr>
<td>Total cost</td>
<td>1st</td>
<td>(Euro/ha)</td>
<td>664</td>
<td>639</td>
<td>715</td>
<td>673</td>
</tr>
<tr>
<td>(Cash cost+)</td>
<td>2nd</td>
<td>(Euro/ha)</td>
<td>416</td>
<td>394</td>
<td>431</td>
<td>413</td>
</tr>
<tr>
<td>Non cash cost</td>
<td>3rd</td>
<td>(Euro/ha)</td>
<td>317</td>
<td>0</td>
<td>446</td>
<td>382</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>(Euro/ha)</td>
<td>466</td>
<td>516</td>
<td>531</td>
<td></td>
</tr>
<tr>
<td>Economic profit</td>
<td>1st</td>
<td>(Euro/ha)</td>
<td>-28</td>
<td>16</td>
<td>90</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>2nd</td>
<td>(Euro/ha)</td>
<td>224</td>
<td>207</td>
<td>332</td>
<td>254</td>
</tr>
<tr>
<td></td>
<td>3rd</td>
<td>(Euro/ha)</td>
<td>243</td>
<td>0</td>
<td>275</td>
<td>259</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>(Euro/ha)</td>
<td>146</td>
<td>111</td>
<td>232</td>
<td></td>
</tr>
<tr>
<td>Opportunity cost</td>
<td>1st</td>
<td>(Euro/ha)</td>
<td>30</td>
<td>30</td>
<td>39</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>2nd</td>
<td>(Euro/ha)</td>
<td>19</td>
<td>15</td>
<td>19</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>3rd</td>
<td>(Euro/ha)</td>
<td>16</td>
<td>0</td>
<td>19</td>
<td>18</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>(Euro/ha)</td>
<td>22</td>
<td>15</td>
<td>26</td>
<td></td>
</tr>
</tbody>
</table>


Note: Total cost is included opportunity cost.

### Appendix-Table 6.9: Break-even yield and break-even price of sugarcane production classified by ratoons and regions

<table>
<thead>
<tr>
<th>Unit</th>
<th>Ratoon</th>
<th>Region</th>
<th>North</th>
<th>Northeast</th>
<th>Central</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>(Tons/ha)</td>
<td>1st</td>
<td>67.1</td>
<td>64.5</td>
<td>72.2</td>
</tr>
<tr>
<td>break-even yield</td>
<td>(Tons/ha)</td>
<td>2nd</td>
<td>41.4</td>
<td>39.2</td>
<td>42.9</td>
<td>41.2</td>
</tr>
<tr>
<td>(TC/price)</td>
<td>(Tons/ha)</td>
<td>3rd</td>
<td>31.7</td>
<td>0.0</td>
<td>44.6</td>
<td>38.2</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>46.7</td>
<td>51.9</td>
<td>53.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>(Euro/ton)</td>
<td>1st</td>
<td>9.3</td>
<td>8.9</td>
<td>10.0</td>
</tr>
<tr>
<td>break-even price</td>
<td>(Euro/ton)</td>
<td>2nd</td>
<td>6.2</td>
<td>5.8</td>
<td>6.4</td>
<td>6.1</td>
</tr>
<tr>
<td>(TC/yield)</td>
<td>(Euro/ton)</td>
<td>3rd</td>
<td>4.5</td>
<td>0.0</td>
<td>6.3</td>
<td>5.4</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>6.6</td>
<td>7.4</td>
<td>7.6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Appendix-Table 6.10: Gross margins of sugarcane production classified by ratoon and region in the production year 2003/2004

<table>
<thead>
<tr>
<th>Ratoon</th>
<th>Unit</th>
<th>Region</th>
<th>North</th>
<th>Northeast</th>
<th>Central</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Euro/ha)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st</td>
<td>33.5</td>
<td>103.9</td>
<td>151.0</td>
<td></td>
<td></td>
<td>96.1</td>
</tr>
<tr>
<td>2nd</td>
<td>295.9</td>
<td>269.3</td>
<td>412.9</td>
<td></td>
<td></td>
<td>326.0</td>
</tr>
<tr>
<td>3rd</td>
<td>266.9</td>
<td></td>
<td>387.8</td>
<td></td>
<td></td>
<td>327.3</td>
</tr>
<tr>
<td>Average</td>
<td>198.8</td>
<td>186.6</td>
<td>317.2</td>
<td></td>
<td></td>
<td>234.2</td>
</tr>
</tbody>
</table>

Appendix to chapter 7

Appendix-Table 7.1: Company groups in the sugar processing industry classified by exporting companies in 2003/04

<table>
<thead>
<tr>
<th>Company group</th>
<th>Number of factories</th>
<th>Crushing capacity/year/factories in 2003/04</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wang Kanai group</td>
<td>4</td>
<td>21,796</td>
</tr>
<tr>
<td>Mitr Phol group</td>
<td>5</td>
<td>16,361</td>
</tr>
<tr>
<td>Tamaka group</td>
<td>4</td>
<td>10,508</td>
</tr>
<tr>
<td>Thai Ekalak group</td>
<td>3</td>
<td>22,267</td>
</tr>
<tr>
<td>Thai Roong Ruang group</td>
<td>7</td>
<td>14,155</td>
</tr>
<tr>
<td>Banpong group</td>
<td>4</td>
<td>13,836</td>
</tr>
<tr>
<td>Kampangpetch group</td>
<td>2</td>
<td>4,769</td>
</tr>
<tr>
<td>Other group</td>
<td>17</td>
<td>10,020</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>46</strong></td>
<td><strong>13,307</strong></td>
</tr>
</tbody>
</table>

Source: Own calculation and OCSB (2003)

Appendix-Table 7.2: Market share of the sugar industry in Thailand

The analysis of the market share of each factory in the sample can not be done due to the limited available information. Therefore, the analysis of market share as an indicator for the competitiveness of the sugar industry can only be shown by the market share of sugar sale representative group and the share of total sale of factory.

Generally, sugar industry in Thailand can be classified in 10 groups according to sugar sale representative. These groups are Wang Kanai, Mitr Phol, Supahanburi, Tamaka, Thai Ekalak, Kaset Phol, Thai Roong Ruang, Banpong, Kampangpetch, other group. There are many sugar factories under each sugar sale representative group. For example, other group comprises of 17 factories. Thai Roong Ruang group comprises of 7 factories. Mitr Phol group, Tamaka group and Wang Kanai group comprise of 4 factories in each group. Banpong group and Thai Ekalak group comprise of 3 factories in each group. Finally, Kumpawapi group and Kampangpetch group comprise of 2 factories in each group.
The information in appendix figure 7.1 shows the market share of sugar industry classified by sugar company branch. It found that other group attained the high percentage share of sugar sale, amounting 22.2%.

The next big category is Thai Roong Rung group, which has the percentage share of sugar sale account for 16.09%. Mitr Phol and Thai Ekalak group has also high percentage share of sugar sale with 15.57% and 14.75% respectively. The rest are Wang Kanai, Tamaka, Banpong, Kaset Phol, Suphanburi and Kampangpetch group. The sugar industry group can also be classified by sugar exporting companies (see Appendix-Table 7.1).

Appendix-Figure 7.1: Market share of the sugar industry classified by sugar company branch

![Market share diagram]

REFERENCE


Johnson, D.M., Lessley, B.V., and J.C. Hanson. 1998. Assessing and Improving Farm Profitability. USA: University of Maryland, Department of Agricultural and Resource Economics,


Reference


