FAKULTÄT AGRARWISSENSCHAFTEN

Aus dem Institut für Landwirtschaftliche Betriebslehre (410b)
Universität Hohenheim

Fachgebiet:
Analyse, Planung und Organisation der landwirtschaftlichen Produktion

Prof. Dr. Drs. h.c. Jürgen Zeddies

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[1] 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 the 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

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

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

1 Rai	=	0.16 ha
1 Baht	=	0.02 Euro

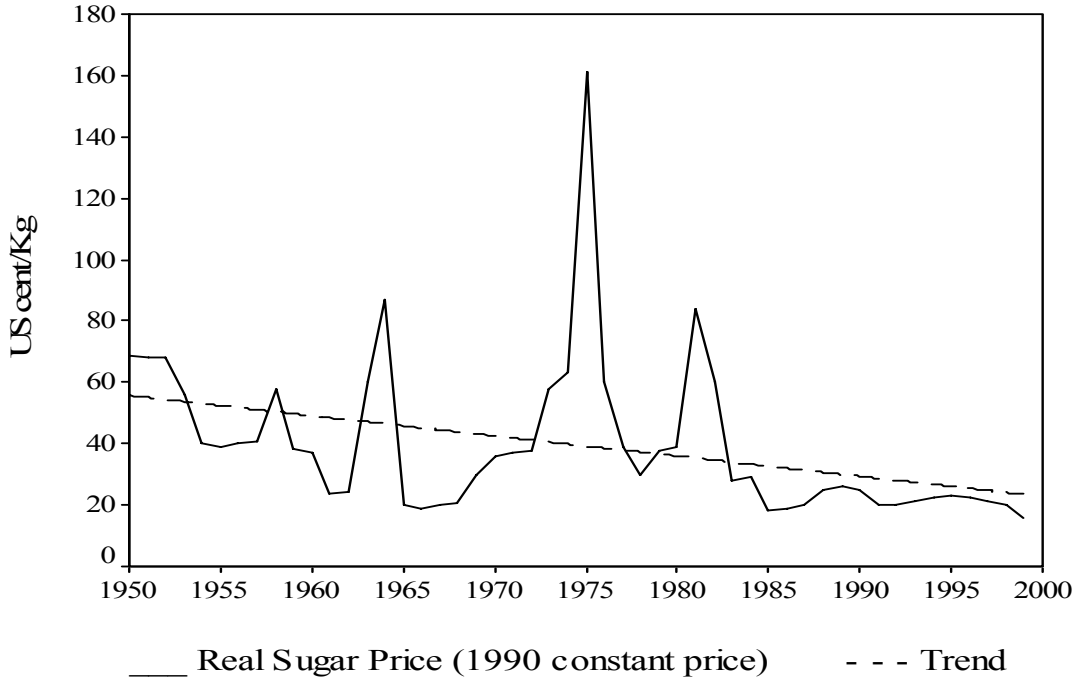
1 INTRODUCTION

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).

Figure 1.1 World price of raw sugar, 1950-1999 deflated by manufactures unit value index (1990=100)



Source: World Bank (1999).

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 planers 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.

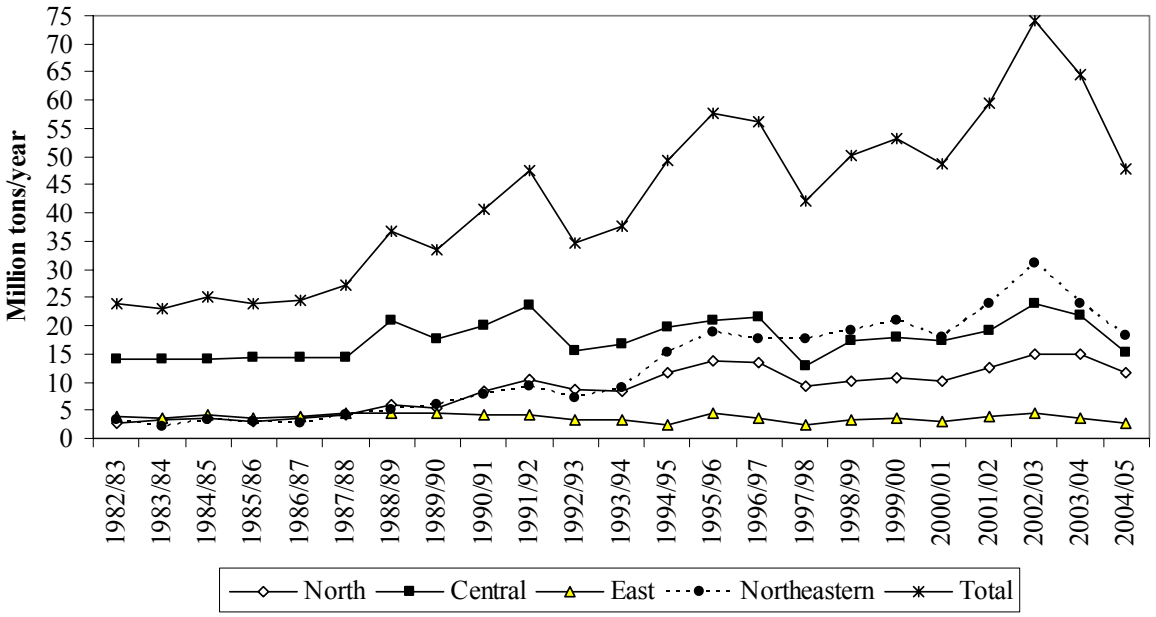
The Thai sugar production shows a pattern of progressive growth in sugarcane production from 1982 to 1997 (Figure 1.2). In 2002/03, the total sugarcane production in the country was about 74.1 million tons.

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[2] 1982/83 to 2004/05



Source: OCSB (1982).

[2] 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).

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 sugar cane 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 and 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,

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[3]

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

	Field (Beet/Cane Production)	**Factory (Processing)**
Natural location factors		
- temperature	- sugar yields	- crushing campaign
- rainfall	- need for irrigation/draining	
- topography	- possibility of machinery use	
Economic location factors		
- opportunity costs of labor, land and capital	- wages, land prices and interest rates	- wages, land prices and interest rates
- productivity	- unit costs	- unit costs
Political location factors		
- subsidies: - product prices, - factor prices	- beet/cane prices, - prices for water, energy etc.	- sugar prices, - prices for water , energy etc.
- taxes	- taxes on income, property and energy etc.	- taxes on income, property and energy etc.
- regulations: - social standards - environmental standards	- non-wage labor costs, - costs, caused by regulations for fertilizer and pesticide use	- non-wage labor costs, - costs, caused by regulations for air emissions, effluents, waste

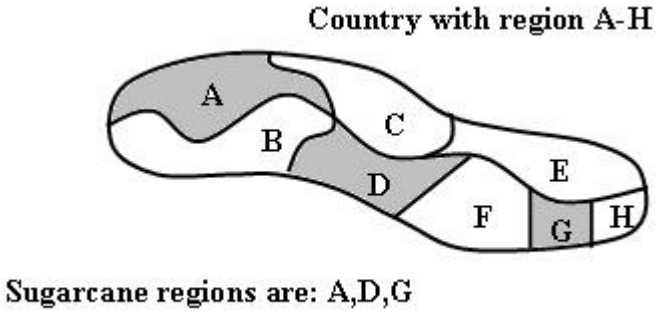
Source: Zimmermann and Zeddies (2001).

2.4 Concept of typical farm approach[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)[5] takes place on whole farm level. For enterprise calculations like *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).

Figure 2.1 Farm area



Source: IFCN (2004) and own modification.

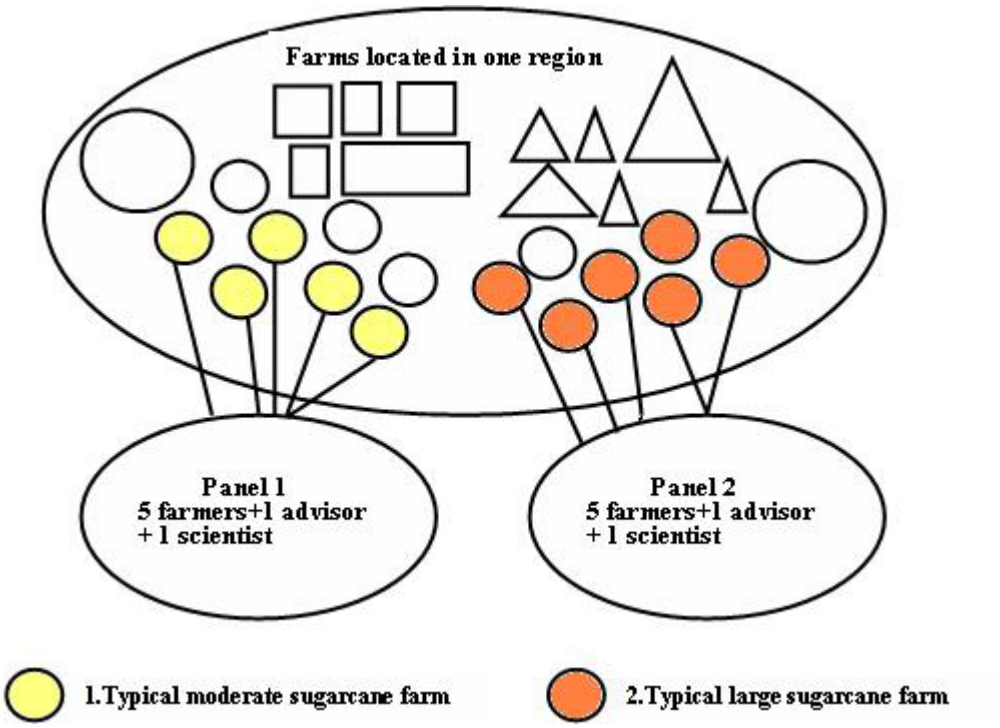
Selection of moderate and large farms: In each region and for each relevant farm type we intend to set up one moderate (average) sized farm and one large farm to represent (a) a significant number of farms, (b) a large amount of production in the area and (c) to capture economies of scale. Size is the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

[4] This section applies from IFCN, 2004.

[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



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 21st in 1994/95-1998/99 to 11th 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[8] 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 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.

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.

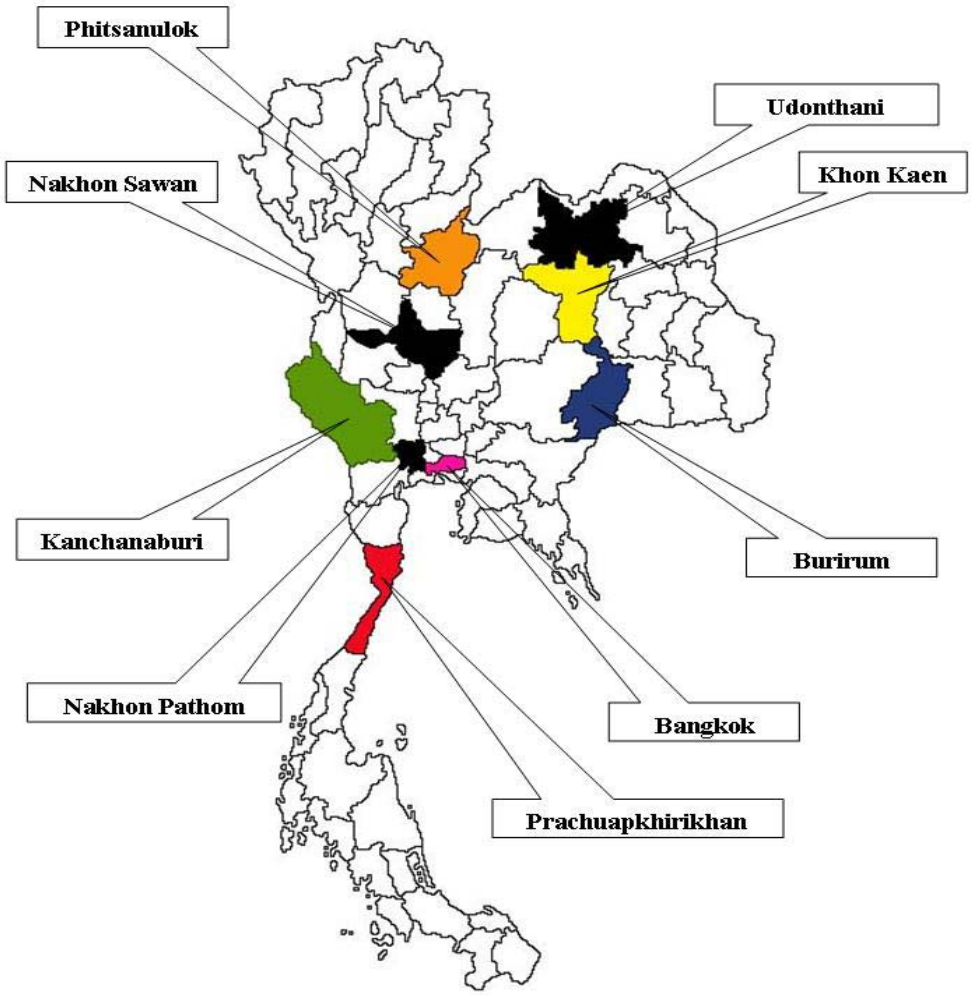
With the factory questionnaire, data was collected on the company profile, cost of sugarcane transport from sugarcane field to factory gate, factory processing costs, environmental regulations and future factory strategies.

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, 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 Prachuapkhirikhan 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 Central, North and Northeastern region.

As described above, this area was chosen because they have been hypothesized to follow 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

Region	**Total irrigated farms**	% of total Farms by region	Farm sampling	**Total rainfed farms**	% of total farms by region	Farm sampling	Total number of farms
Central	21,594	27.1	2	58,052	72.9	4	79,646
Northeastern	325	0.7	0	44,001	99.3	6	44,326
North	1,054	2.5	0	40,771	97.5	6	41,825
Total			**2****			**16****	
Eastern*	32	0.4	0	8,497	99.6	6	8,529
Total							174,326

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

Region	**Total number of sugarcane farms**			**Sample requirement**	**Sample obtained from interview**			**Total**
	Small	**Medium**	**Large**		**Small**	**Medium**	**Large**	
Central	70,262 (88)* (5.29)** (5) ***	7,250 (9)* (0.55)** (1) ***	2,134 (3)* (0.16)** (0) ***	6	7	3	2	12
Northeastern	37,083 (84)* (5.02)** (5) ***	5,838 (13)* (0.79)** (1) ***	1,405 (3)* (0.19)** (0) ***	6	5	1	4	10
North	34,348 (82)* (4.93)** (5) ***	5,678 (14)* (0.81)** (1) ***	1,799 (4)* (0.26)** (0) ***	6	5	1	1	7
Thailand (Total)	**15**	**3**	**0**	**18**	**17**	**5**	**7**	**29**

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

Region	Size	Group	Number of factories	Factory name
Central	***Large***	Mitr Phol	1	
	Medium	Tamaka	1	Tamaka
		Thai Roong Ruang	1	Saraburi
		Wang Kanai	3	Wangkanai
				U-Thong
				T.N.Sugar
	Small	Banpong	2	Banpong
				Singburi
		Tamaka	1	New Krung Thai
		Thai Roong Ruang	3	Karnchanaburi industry
				Thai Sugar industry
				Thai Multi-Sugar Industry
		Other	6	Suphanburi Sugar Industry
				Rajburi
				Mitr Kasetr Industry
				Prachuap Industry
				Thai Sugar Mill
				Pranburi
		Total	18	
Northeast	***Large***	Other	1	
	Medium	Mitr Phol	3	Mitr Kalasin
				United Farm & Industry
				Mitr Phu Viang
		Kumpawapi	2	Kumphawapi
				Kaset Phol
		Tamaka	1	Khon Kaen
		Wang Kanai	1	Angvian (Ratchasima)
		Other	2	N.Y. Sugar
				Rermudom
	Small	Other	3	Burirum
				E-Saan Sugar Industry
				Saharuang
		Total	13	

Table 3.3 Structure of the sugar industry in Thailand (continue)

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

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

No	Region	Size	Factory name
1	Northern	Large	A sugar factory
2	Northern	Small	B sugar factory
3	Central	Small	C sugar factory
4	Central	Small	D sugar factory
5	Northeastern	Small	E sugar factory

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 are 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

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

Source: Nott, Betz and Schwab (2006).

Table 3.5 Calculation of sugarcane production cost (continue)

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

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 in 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:

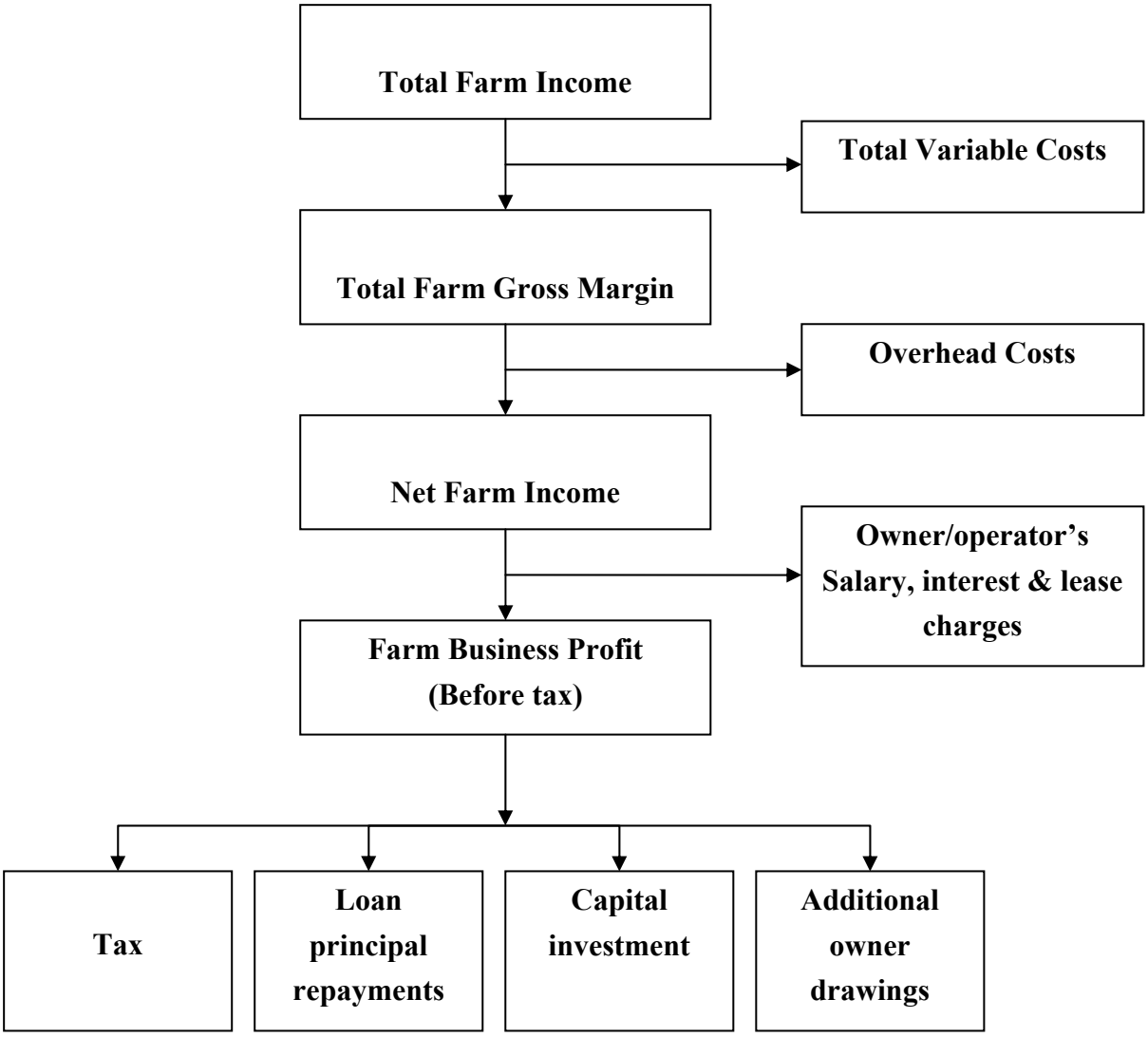
Gross margins are comparable when examining similar enterprises. They are consistently understood and calculated (HA 2005).

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.

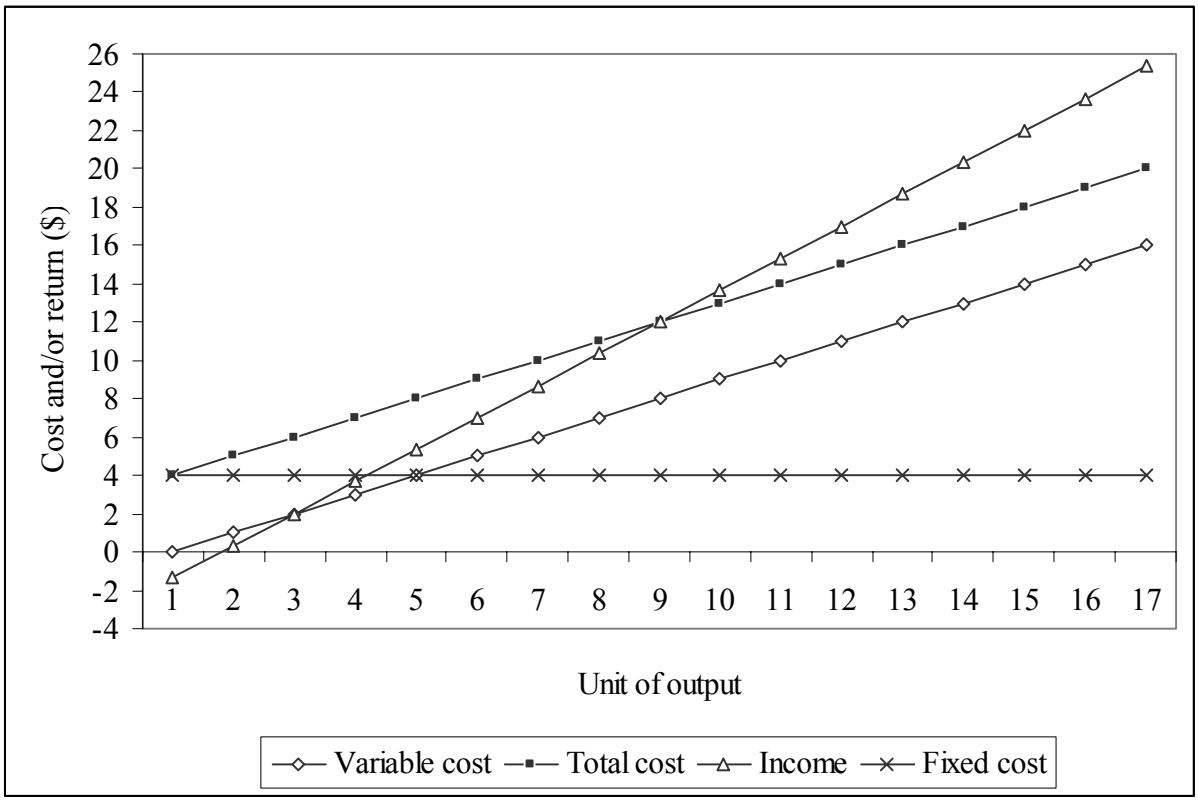
Fixed costs

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 about18.87 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

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

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.

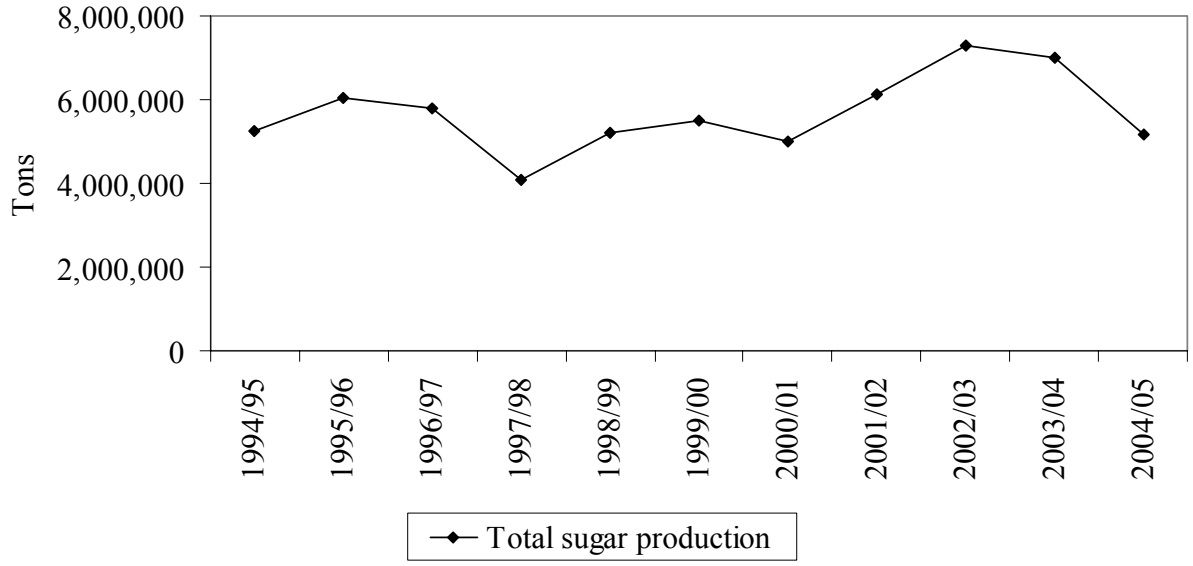
Food and Drug Administration notes raw sugar is "unfit for direct use as food or as a food ingredient because of the impurities it ordinarily contains" (ASA, 2005).

[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.

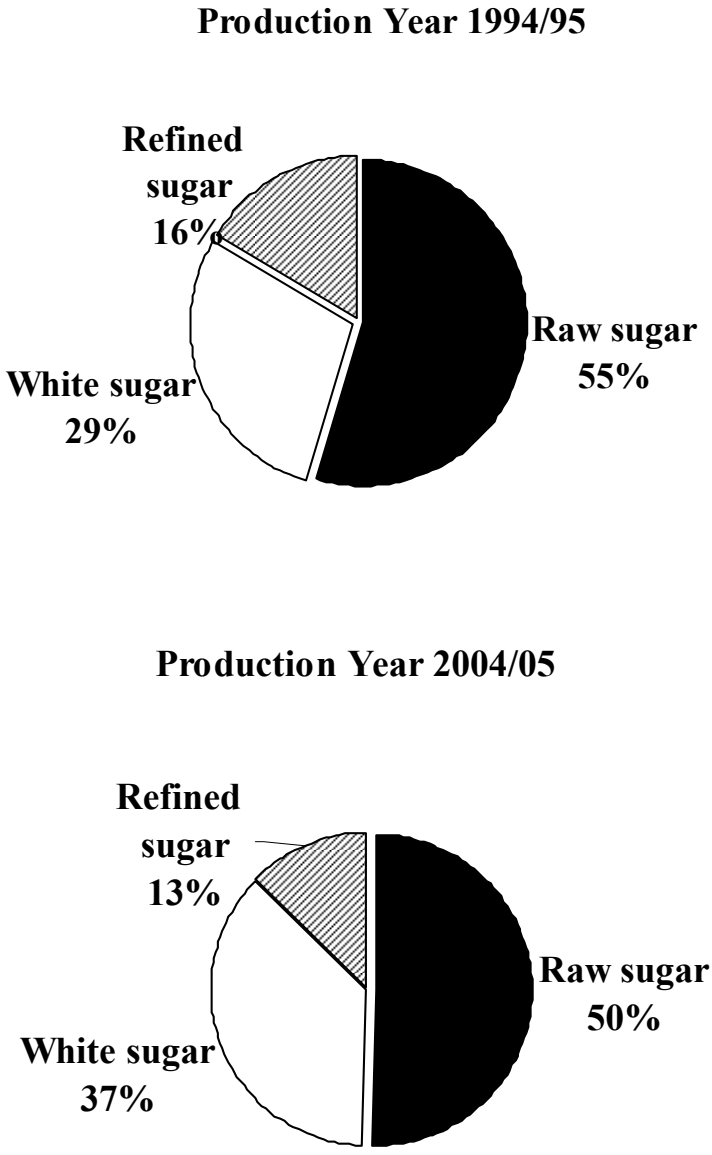
Figure 4.1 Development of sugar production in Thailand from production year 1994/95 to 2004/05



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



Source: OCSB (2005) and own modification.

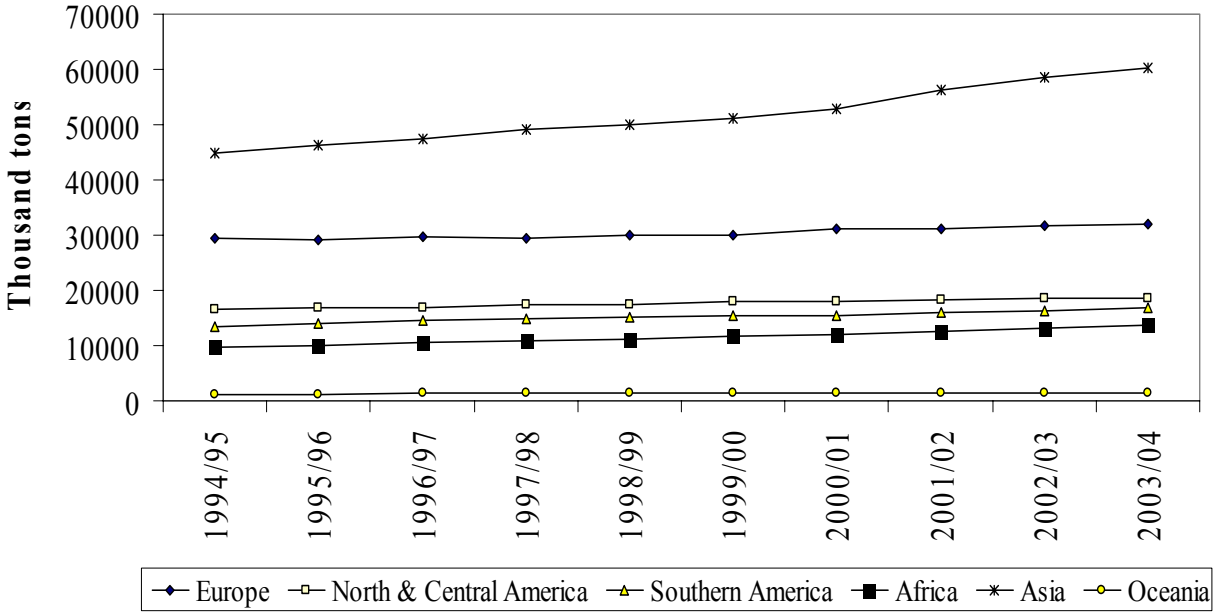
4.1.2 Sugar consumption

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



Source: OCSB (2004) and own modification.

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.

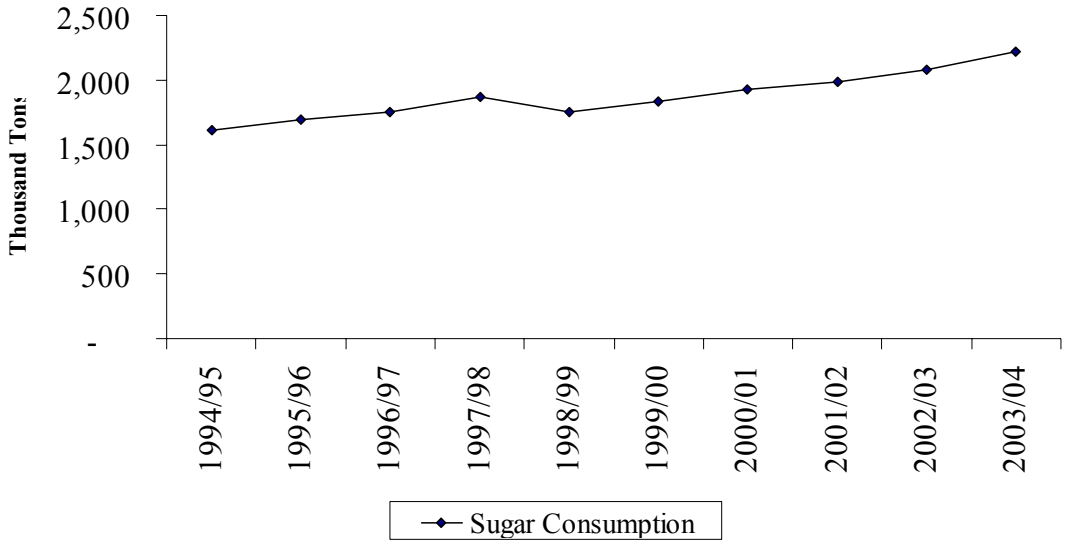
Table 4.2 Development of sugar production and consumption in Thailand

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

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

	Plantation white sugar			**Refined sugar**		
Year	Domestic consumption (Tons)	Income (Baht)	Average price* (Baht/ton)	Domestic consumption (Tons)	Income (Baht)	Average price* (Baht/ton)
1990	695,706	7,644,730,357	10,989	327,624	3,795,584,101	11,585
1991	746,593	8,203,472,644	10,988	354,783	4,110,139,385	11,585
1992	792,888	8,712,548,749	10,988	377,419	4,372,215,586	11,585
1993	841,150	9,243,453,014	10,989	425,719	4,939,506,546	11,603
1994	729,830	8,020,011,592	10,989	640,431	7,438,269,295	11,615
1995	1,006,129	11,061,915,411	10,995	517,280	5,998,614,303	11,597
1996	1,052,420	11,573,034,686	10,997	527,624	6,117,807,176	11,595
1997	1,157,671	12,730,574,574	10,997	553,962	6,422,445,806	11,594
1998	1,176,675	12,943,311,505	11,000	521,449	6,074,588,299	11,649
1999	1,164,897	12,805,186,830	10,993	479,991	5,591,893,256	11,650
2000	1,266,626	14,458,857,474	11,415	414,850	5,008,166,331	12,072
2001	1,357,296	15,965,107,440	11,762	452,622	5,642,156,612	12,466
2002	1,371,531	16,128,891,614	11,760	460,035	5,734,561,693	12,466
2003	1,453,433	17,095,209,424	11,762	489,805	6,105,667,880	12,466
2004	1,397,457	16,434,605,434	11,760	453,861	5,657,604,271	12,466

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)

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

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

Year	Domestic consumption (Tons)			Share (%)		
	Household consumption	Industry consumption	Total	Household consumption		Industry consumption
1991	822,396.62	278,979.12	1,101,375.74	74.67	:	25.33
1992	854,603.87	315,703.05	1,170,306.91	73.02	:	26.98
1993	936,353.00	330,516.69	1,266,869.69	73.91	:	26.09
1994	1,022,136.08	348,124.41	1,370,260.49	74.59	:	25.41
1995	1,183,327.60	340,081.43	1,523,409.03	77.68	:	22.32
1996	1,204,483.28	375,560.47	1,580,043.75	76.23	:	23.77
1997	1,217,014.48	494,618.65	1,711,633.13	71.1	:	28.9
1998	991,095.08	707,028.60	1,698,123.68	58.36	:	41.64
1999	938,544.57	706,343.16	1,644,887.73	57.06	:	42.94
2000	985,990.95	695,484.90	1,681,475.85	58.64	:	41.36
2001	1,251,660.27	558,257.90	1,809,918.17	69.16	:	30.84
2002	1,265,714.14	565,851.40	1,831,565.54	69.11	:	30.89
2003	1,327,480.02	615,758.30	1,943,238.32	68.31	:	31.69
2004	1,265,192.35	586,125.15	1,851,317.50	68.34	:	31.66

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

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

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

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

Continent		Asia	Africa	Oceania
Raw sugar	Quantity (Tons)	2,239,234	23,732	394
	Value (Baht)	13,880,218,710	159,130,536	3,487,973
	Price (Baht/tons)	6,199	6,705	8,853
	% of quantity	**49.04**	35.39	9.10
Plantation white sugar	Quantity (Tons)	1,366,605	10,405	128
	Value (Baht)	10,913,012,152	78,419,892	1,327,551
	Price (Baht/tons)	7,985	7,537	10,371
	% of quantity	29.93	15.52	2.95
Refined sugar	Quantity (Tons)	959,909	32,925	3,811
	Value (Baht)	7,594,954,106	229,627,355	38,890,685
	Price (Baht/tons)	7,912	6,974	10,205
	% of quantity	21.02	**49.10**	**87.95**
Total	Quantity (Tons)	4,565,748	67,062	4,333
	Value (Baht)	32,388,184,967	467,177,783	43,706,209
	Price (Baht/tons)	7,094	6,966	10,087
	% of quantity	100	100	100
% 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)

Continent		America	Europe	Total (Tons)
Raw sugar	Quantity (Tons)	14,244	5,000	2,282,605
	Value (Baht)	189,863,808	30,535,000	14,263,236,026
	Price (Baht/tons)	13,329	6,107	6,249
	% of quantity	**94.28**	**96.34**	49.01
Plantation white sugar	Quantity (Tons)	864	-	1,378,002
	Value (Baht)	7,255,779	-	11,000,015,373
	Price (Baht/tons)	8,398	-	7,983
	% of quantity	5.72	0.00	29.59
Refined sugar	Quantity (Tons)	-	190	996,835
	Value (Baht)	-	2,197,529	7,865,669,676
	Price (Baht/tons)	-	11,566	7,891
	% of quantity	0.00	3.66	21.40
Total	Quantity (Tons)	15,108	5,190	4,657,441
	Value (Baht)	197,119,587	32,732,529	33,128,921,075
	Price (Baht/tons)	13,047	6,307	7,113
	% of quantity	100	100	100
% of total quantity		0.32	0.11	100.00

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

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

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)

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

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

	Raw sugar			White sugar			Total	
Production year	Quantity (ton)	Share (%)	Value (Million Bath)	Quantity (ton)	Share (%)	Value (Million Bath)	Quantity (ton)	Value (Million Bath)
1995/96	2,780,900	75.3	20,690.11	912,020	24.7	7,693.87	3,692,920	28,383.98
1996/97	2,854,960	65.7	19,288.73	1,490,260	34.3	12,154.99	4,345,220	31,443.72
1997/98	2,524,700	61.6	17,984.65	1,570,560	38.4	13,820.71	4,095,260	31,805.36
1998/99	1,386,990	60.0	14,371.25	926,470	40.0	11,618.97	2,313,460	25,990.22
1999/00	1,997,622	61.1	11,349.53	1,271,477	38.9	9,552.43	3,269,099	20,901.96
2000/01	2,321,692	56.8	13,366.87	1,765,741	43.2	12,383.41	4,087,433	25,750.28
2001/02	2,218,286	68.3	20,098.16	1,028,010	31.7	10,500.89	3,246,296	30,599.05
2002/03	2,059,789	51.1	12,935.12	1,969,159	48.9	16,448.69	4,028,948	29,383.81
2003/04	2,549,512	50.3	17,624.89	2,515,318	49.7	20,807.46	5,064,830	38,432.35
2004/05	2,235,205	48.6	13,975.68	2,364,833	51.4	18,639.47	4,600,038	32,615.15
2005/06	1,583,634	52.1	13,422.54	1,457,762	47.9	14,903.37	3,041,396	28,325.91
Average	2,228,480	58.7	15,918.87	1,570,146	41.3	13,502.21	3,798,627	29,421.07

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

Year	Total imports (Tons)	Average price (Baht/ton)	Value (Baht)	Country of Origin
1995	2.00	23,959.00	47,918.00	Japan
1996	9.00	58,830.54	529,474.86	Japan, Great Britain
1997	4.00	12,646.88	50,587.52	Japan
1998	17.32	104,549.60	1,810,799.07	Japan, Belgium
1999	20.25	10,468.71	211,991.38	Australia, Belgium
2000	-	-	-	-
2001	6.44	68,367.39	440,285.99	Great Britain, Mauritius
2002	5.36	52,409.48	281,103.49	Belgium,United Arab Emirates
2003	100.04	17,502.70	1,750,970.11	China, France

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[12]. 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 4.11 Development of the Sugar quotas in Thailand (Tons)

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

Source: Sugarzone (2001).

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

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

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.

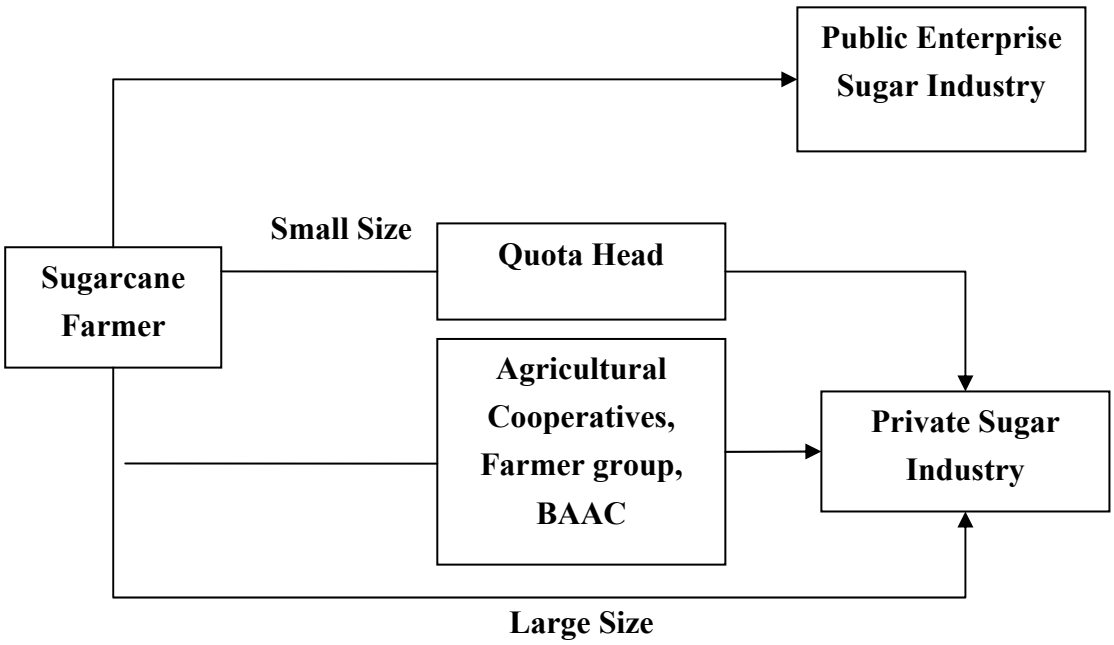
The "look rai", or contracting farmer is the farmer who depends upon the sugarcane quota head. The quota head often provides farm inputs to his "look rai", to enable them to produce enough quantity of sugarcane for their quota. The farm inputs usually supplied are capital, fertilizer, herbicide, insecticide. 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).

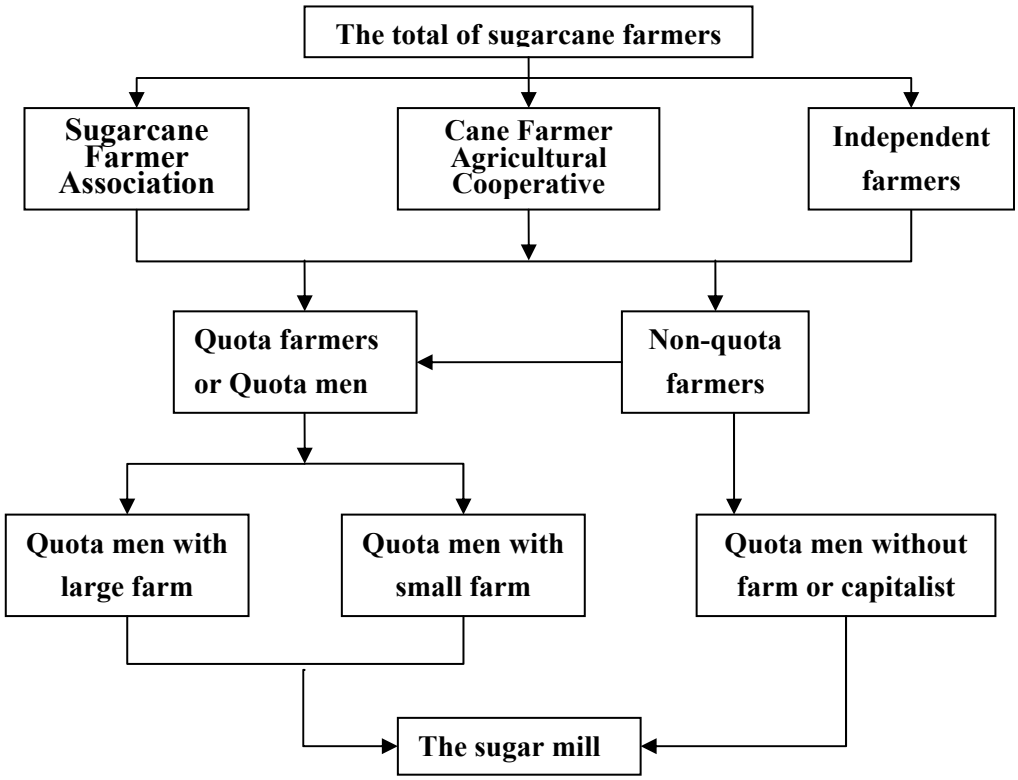
Note: BAAC is Bank for Agriculture and Agricultural Cooperatives.

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



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

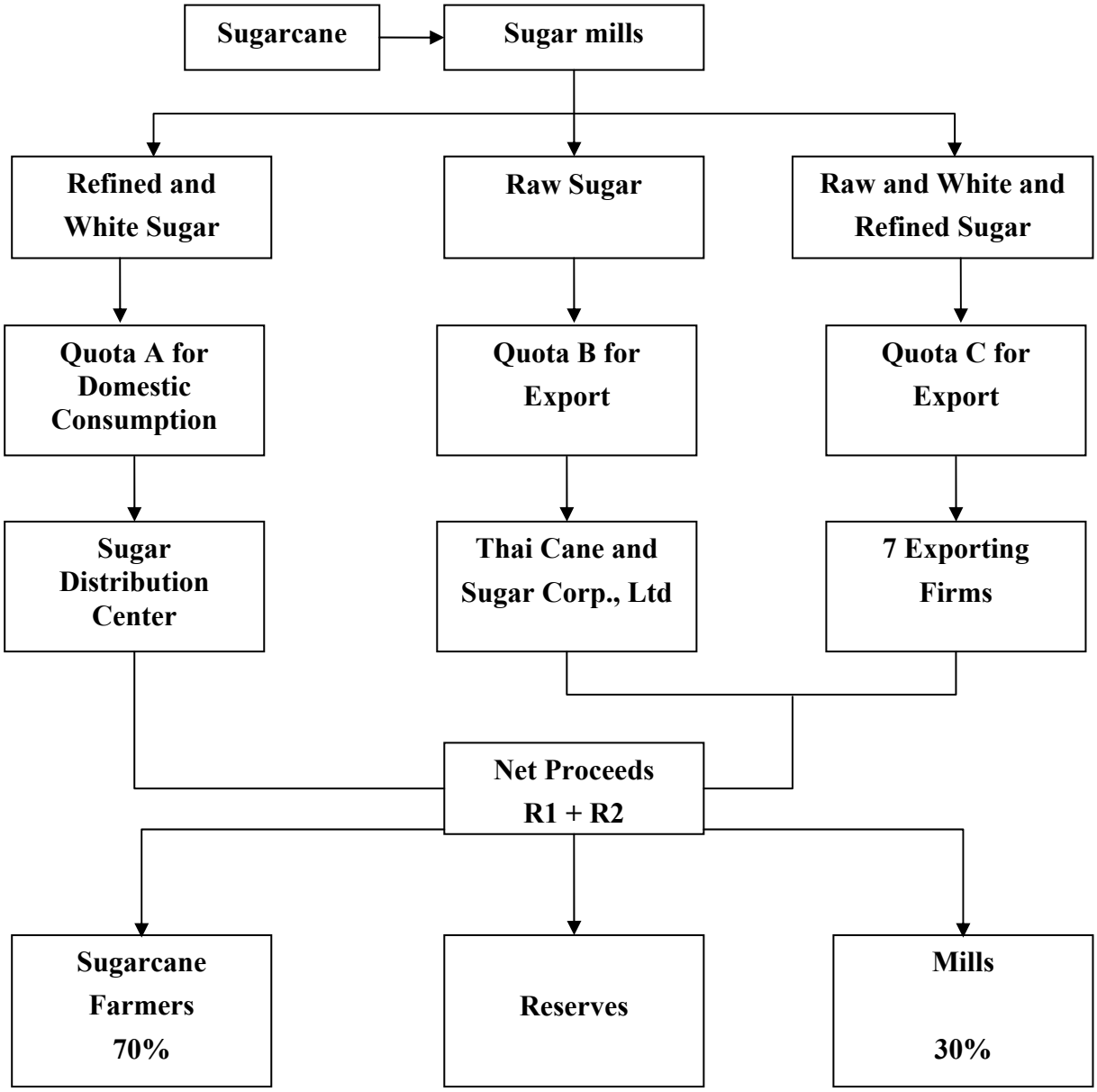
In 1982/83 crop year, the net proceeds sharing system of 70: 30 was first introduced. This new sugarcane payment system will do away with arguments and bargaining between the sugarcane growers and millers beginning of the season as ever before. Now sugarcane is sold milled and the sugar sold domestically 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).

Figure 4.7 Management of Revenue Sharing System



Source: OCSB (1990a).

The calculation of sugarcane price has two parts. First, the calculation of sugarcane price without considering the commercial cane sugar[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

[13] C.C.S. is the symbol for "commercial cane sugar".

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:

$$Pc = \frac{0.7(R_1 + R_2)}{Q_c} \tag{4.1}$$

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

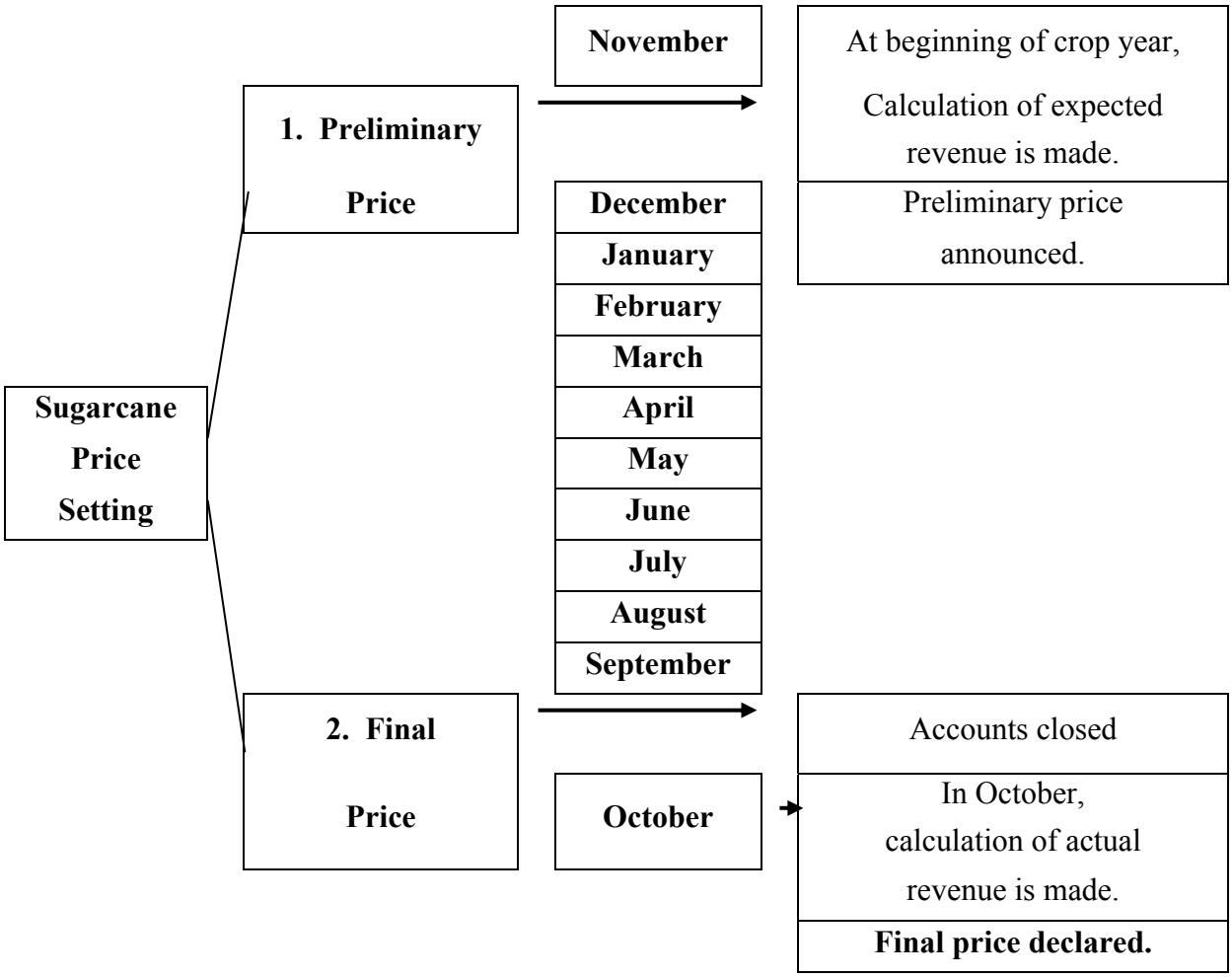
The present formula in calculation sugarcane price follows to the Cane and sugar act in 1984. The formula is as follows:

$$Pc = P_1 + P_2 * CCS + M \tag{4.2}$$

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



Source: OCSB (1990b).

(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

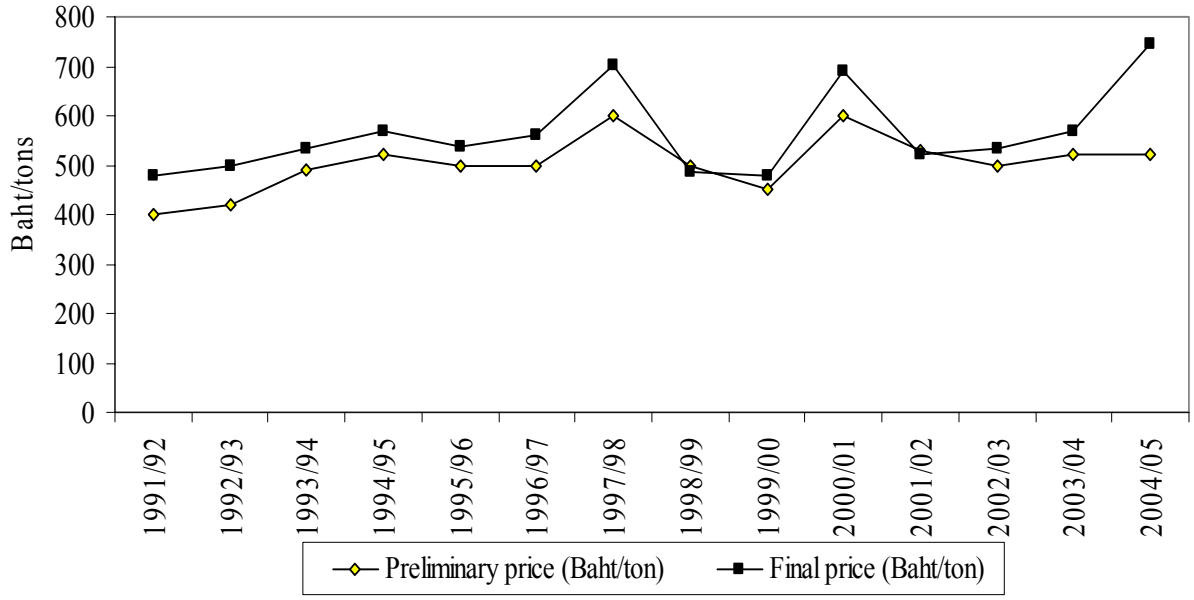
At the end of the following September during which domestic sale, export's revenue as well as sugarcane quantity milled in the season are known, calculation of actual revenues derived from the actual domestic sale, export's

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



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

	Preliminary price*		Final price		Different
Production year	(Baht/ton)	(Euro/ton)**	(Baht/ton)	(Euro/ton)**	
1991/92	399.00	7.98	480.00	9.60	81.00
1992/93	420.00	8.40	499.30	9.99	79.30
1993/94	490.00	9.80	533.01	10.66	43.01
1994/95	520.00	10.40	569.27	11.39	49.27
1995/96	500.00	10.00	537.61	10.75	37.61
1996/97	500.00	10.00	560.85	11.22	60.85
1997/98	600.00	12.00	702.59	14.05	102.59
1998/99	500.00	10.00	484.59	9.69	-15.41
1999/00	450.00	9.00	478.27	9.57	28.27
2000/01	600.00	12.00	688.71	13.77	88.71
2001/02	530.00	10.60	520.49	10.41	-9.51
2002/03	500.00	10.00	533.82	10.68	33.82
2003/04	465.00	10.40	568.00	11.36	103.00
2004/05	620.00	10.42	657.00	14.90	37.00

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.

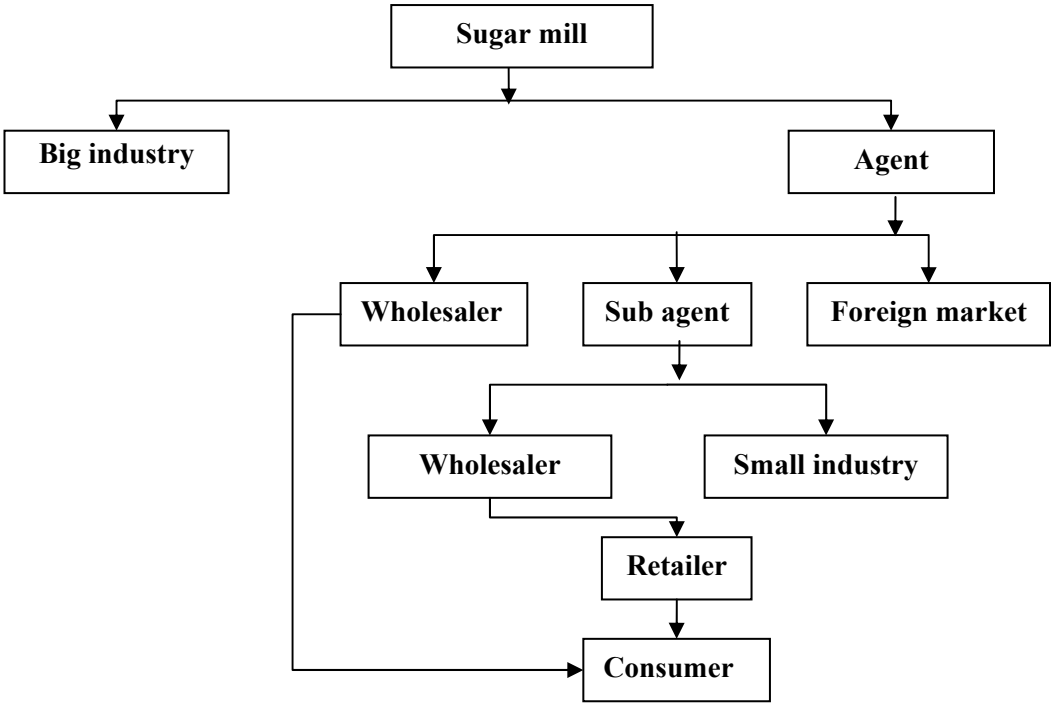
To sum up, the price of sugarcane and sugar has been the only thing that every party involved is concerned with. Since the government acts as the mediator according to the Cane and Sugar Act 1984, it always becomes the target of all sorts of demands from the parties involved. In the last few years, both 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



Source: Biz Dimension (2006).

The diagram indicates that sugar mill managers sell their sugar to agents and to some big industries, such as soft drink and food cannery. 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.

Table 5.1 Development of sugar cane production in Thailand

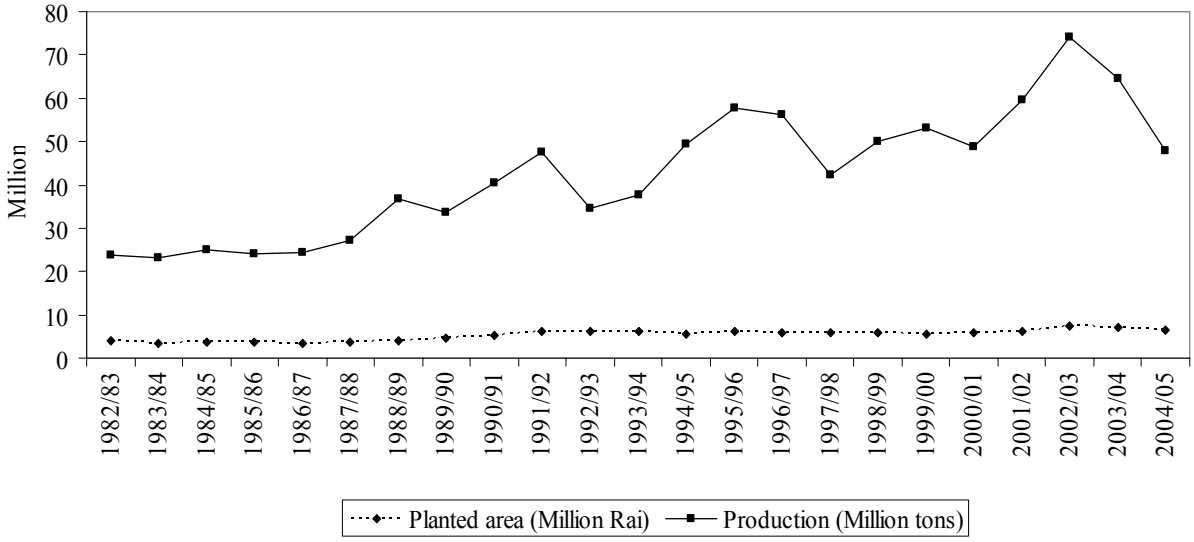
Production year	Sugarcane planted area (million rai)	Sugarcane planted area (million ha)	Sugarcane production (million tons)	Average yield of sugarcane (Tons/rai)	Average yield of sugarcane (Tons/ha)
1982/83	4.08	0.65	23.92	5.86	36.62
1983/84	3.52	0.56	23.09	6.57	44.04
1984/85	3.80	0.61	25.05	6.58	41.16
1985/86	3.84	0.61	24.00	6.25	39.06
1986/87	3.46	0.55	24.44	7.06	44.10
1987/88	3.75	0.60	27.19	7.25	45.30
1988/89	4.13	0.66	36.70	8.89	55.53
1989/90	4.56	0.73	33.56	7.36	46.00
1990/91	5.28	0.85	40.56	7.68	48.00
1991/92	6.06	0.97	47.50	7.84	48.99
1992/93	6.14	0.98	34.71	5.65	35.33
1993/94	6.03	0.96	37.57	6.23	38.94
1994/95	5.64	0.90	49.31	8.74	54.64
1995/96	6.24	1.00	57.69	9.25	57.79
1996/97	5.89	0.94	56.19	9.54	59.63
1997/98	5.75	0.92	42.20	7.34	45.86
1998/99	5.89	0.94	50.06	8.49	53.08
1999/00	5.62	0.90	53.13	9.46	59.13
2000/01	5.81	0.93	48.65	8.38	52.37
2001/02	6.04	0.97	59.49	9.85	61.56
2002/03	7.44	1.19	74.07	9.95	62.19
2003/04	7.00	1.12	64.48	9.21	57.59
2004/05	6.34	1.01	47.82	7.54	47.11

Source: OCSB (2004).
Note: 1 rai = 0.16 ha

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

it declined significantly to less than 50 million tons in crop year 2004/05 as the result of the declined price of sugar cane.

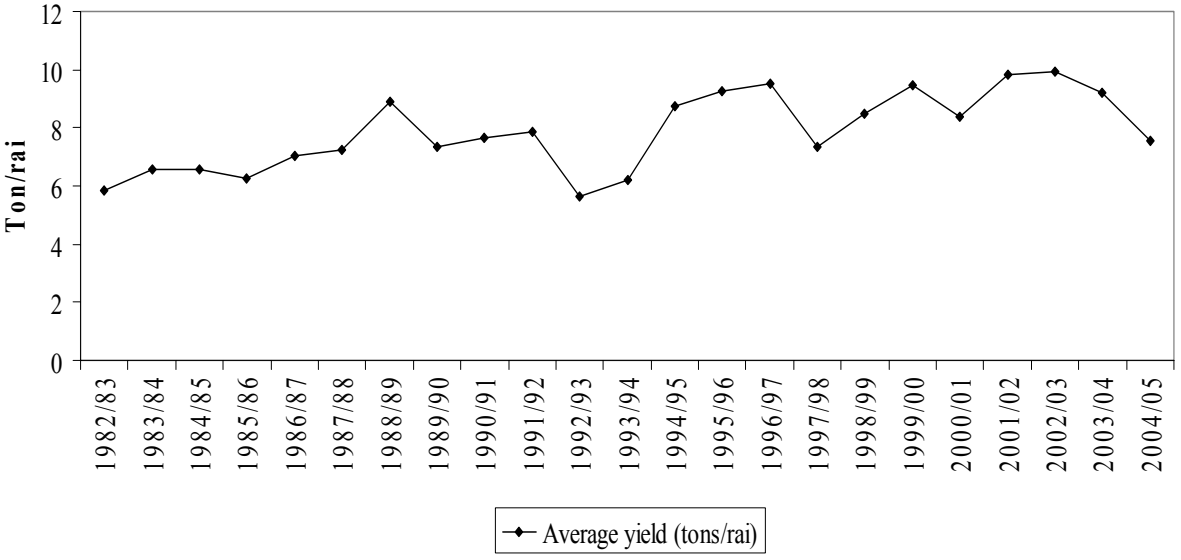
Figure 5.1 Development of sugarcane production and planted area in Thailand



Source: OCSB (2004).

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

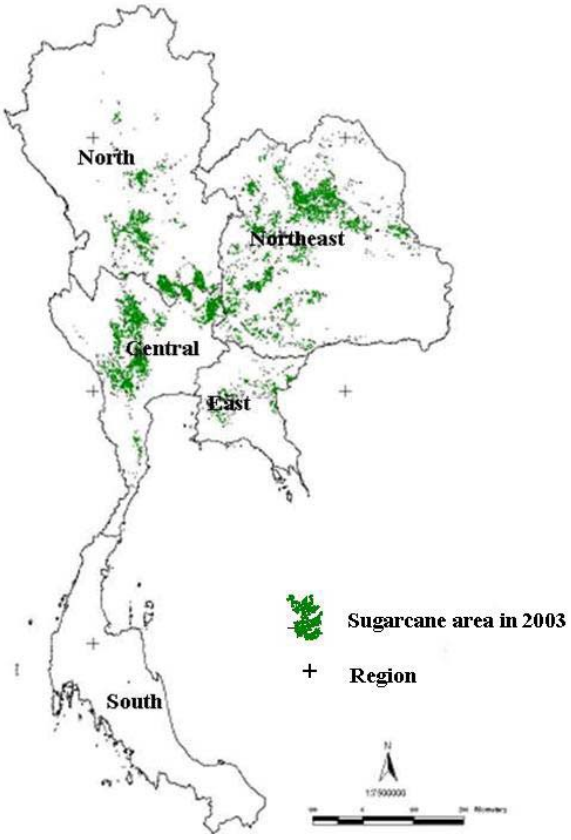


Source: OCSB (2005).

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

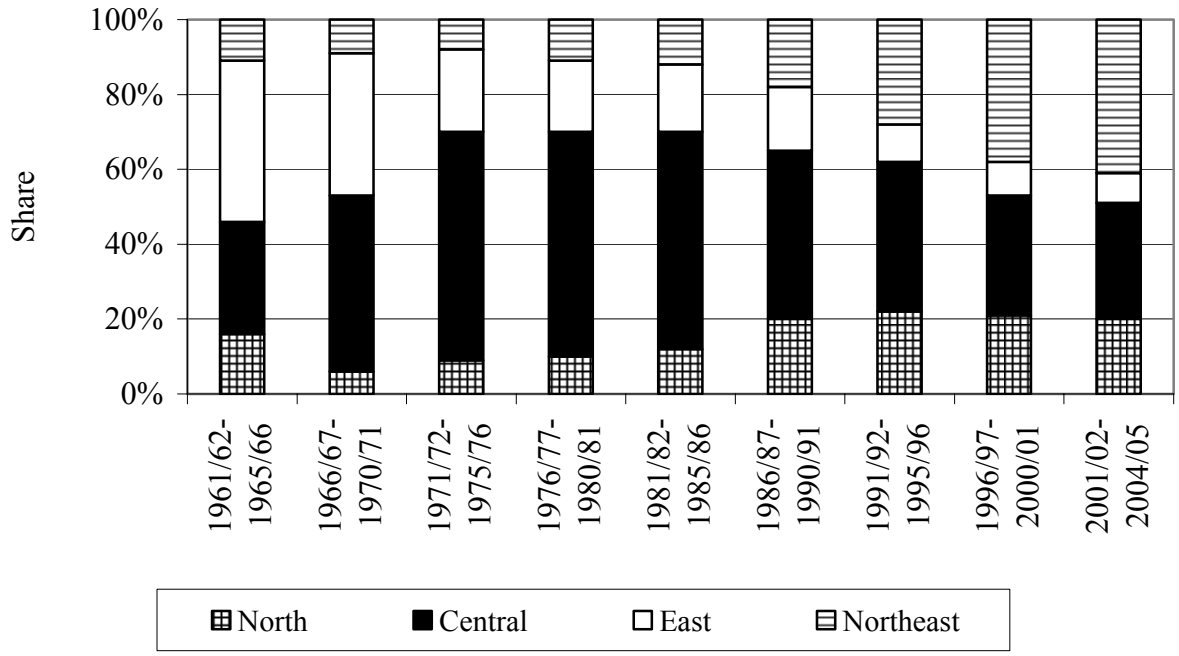


Source: OCSB (2005) and own modification.

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



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

Region	Sugarcane area		Sugarcane area (%)
	(rai)	(ha)	
Northeast	2,723,886	435,822	42.94
Central	2,021,076	323,372	31.86
North	1,207,038	193,126	19.03
East	391,372	62,620	6.17
Total	**6,343,372**	**1,014,940**	**100.00**

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 5.3 Structure of sugarcane farms in Thailand

Region	Farm size (sugarcane area)						Total Number of cane farms	Share (%)
	Small (< 59 rai)		Medium (60-199 rai)		Large (> 199 rai)			
	Number of farms	Share (%)	Number of farms	Share (%)	Number of farms	Share (%)		
North	34,348	82.1	5,678	13.6	1,799	4.3	41,825	24.0
Central	70,262	88.2	7,250	9.1	2,134	2.7	79,646	45.7
Northeast	37,083	83.7	5,838	13.2	1,405	3.2	44,326	25.4
East	5,433	63.7	2,101	24.6	995	11.7	8,529	4.9
Total	**147,126**	**84.4**	**20,867**	**12.0**	**6,333**	**3.6**	**174,326**	**100.0**

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

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

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

Activities	Month															
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1. Breaking sugarcane ratoon and plowing	■	■	■	■												
2. Plowing second time, ripper	■	■	■	■												
3. Planting		■	■	■	■											
4. Herbicide		■	■	■	■											
5. Fertilizing						■	■									
6. Herbicide and weeding						■	■									
7. Soil cultivating										■	■	■				
8. Harvesting (1^{st} stubble)															■	■

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 (Aleurololus 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 (Dorysthenas 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

Northern region		
Province	**Number of Factories**	**Name of the Factories**
Chiangmai	1	Chiangmai
Lampang	1	Mae Wang Sugar Industry
Uttaradit	2	Uttaradit Sugar Industry
		Thai Identity
Kamphaengphet	2	Kampangpetch
		Nakornpetch
Nakhonsawan	2	Ruamphol Nakhonsawan
		Kaset Thai
Phitsanulok	1	Phitsanulok
Phetchabun	1	Thai Roong Ruang Industry
Total	**10**	
Eastern region		
Province	**Number of Factory**	**Name of Factory**
Chonburi	3	Chonburi Sugar Industry
		New Kwang Soon Lee
		Chonburi Sugar & Trading
Rayong	1	Rayong
Sakaew	1	Eastern Sugar
Total	**5**	

Source: OCSB (2004).

Table 5.6 Structure of the sugar industry in Thailand classified by province (continue)

Central region		
Province	**Number of Factories**	**Name of the Factories**
Prachuapkirikhan	1	Pranburi
Ratchaburi	2	Ratchaburi
		Pong
Kanchanaburi	8	Mitr Kasetr
		Thai Sugar Mill
		New Krung Thai
		Thai Multi-Sugar Industry
		Tamaka
		Prachuap Industry
		Thai Sugar Industry
		Wang Kanai
Saraburi	1	Saraburi
Lopburi	1	T.N. Sugar
Suphanburi	3	Suphanburi Sugar Industry
		Mitr Phol
		U-thong
Singburi	1	Singburi
Uthaithani	1	Kanchanaburi Industry
Total	**18**	
Northeastern region		
Province	**Number of Factories**	**Name of the Factories**
Burirum	1	Burirum
Mukdahan	1	Saharuang
Udonthani	3	Rerm Udom
		Kaset Phol
		Kumpawapi
Khon Kaen	2	Khon Kaen
		Mitr Phu Viang
Chaiyaphum	1	United Farmer & Industry
Nakhonratchasima	3	Korach Industry
		Angvian (Ratchasima)
		N.Y. Sugar
Kalasin	2	E - Saan Sugar Industry
		Mitr Kalasin
Total	**13**	

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 conveyer 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:

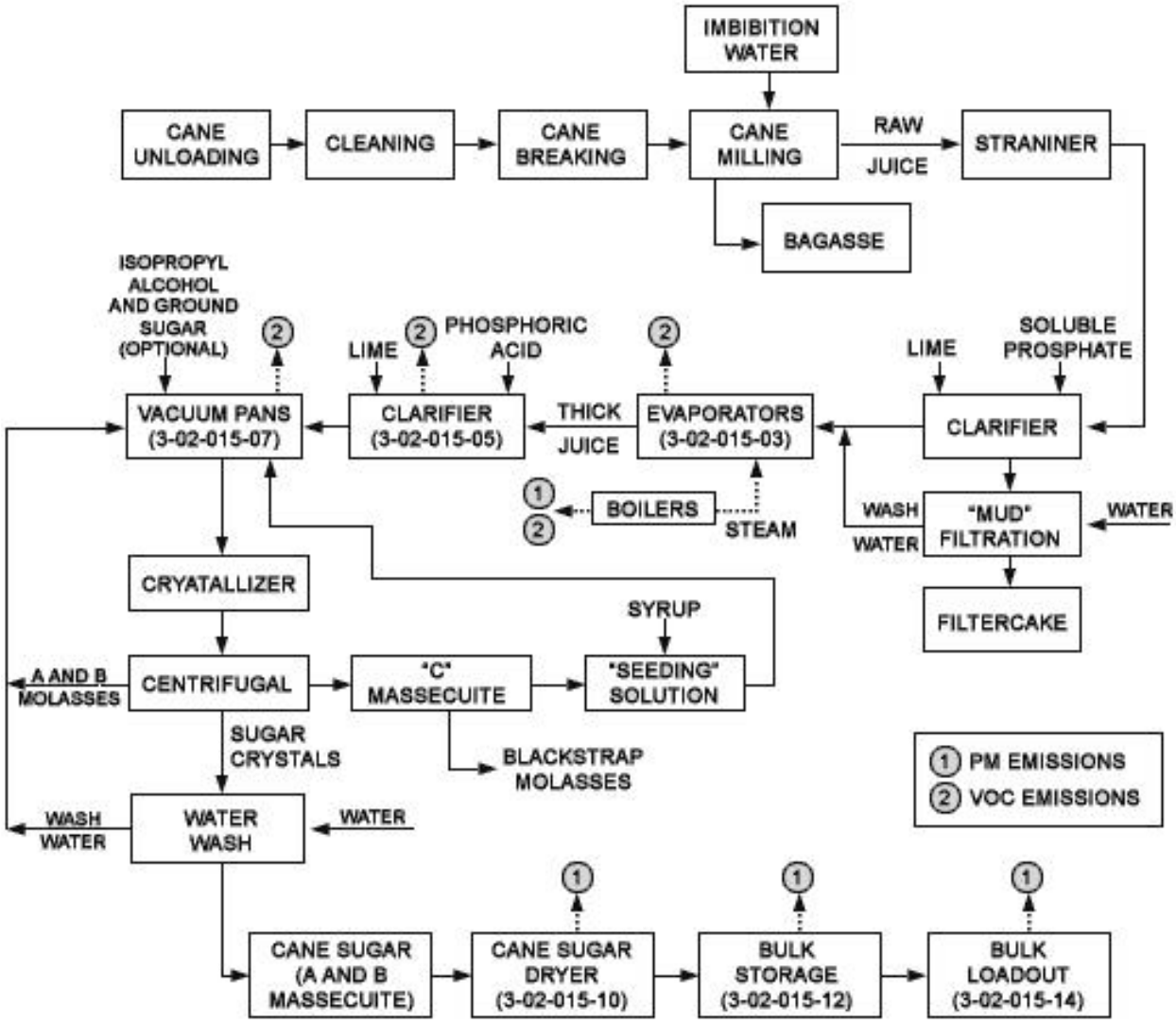
The filtered juice is evaporated under a vacuum, concentrated at a low temperature, and the sugar crystallized in vacuum pans.

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



Source: Biz Dimension (2006).

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.

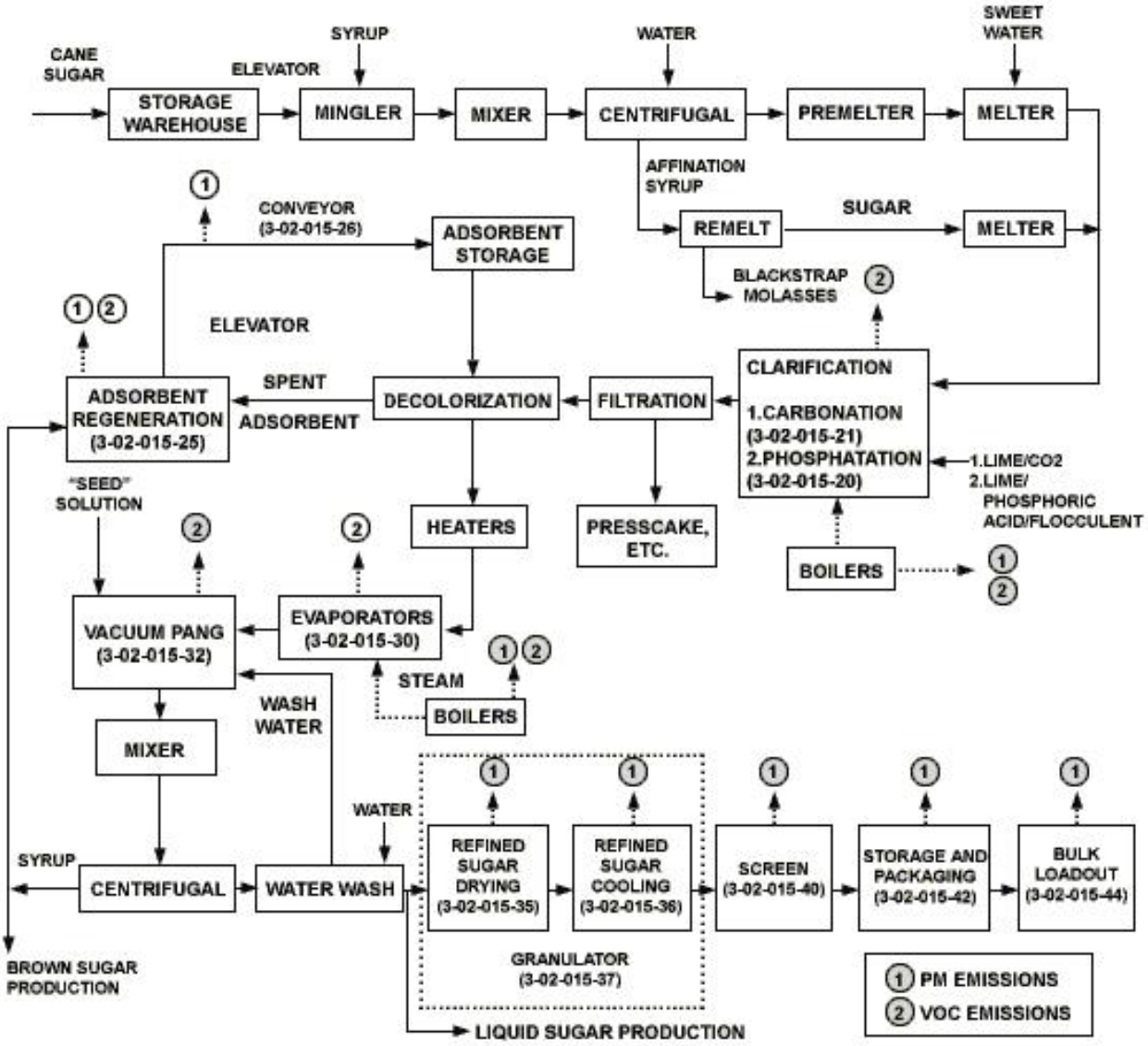
Screening:

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



Source: Biz Dimension (2006).

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

Region/Province	Sugarcane Production (Million tons)			Sugarcane Yield (tons per rai)			Sugarcane Yield (tons per hectare)		
	2003	2004	2005	2003	2004	2005	2003	2004	2005
North									
Nakhon Sawan	4.3	4.2	3.5	10.1	9.3	7.6	63.2	58.0	47.6
Northeast									
Udonthani	5.9	4.7	3.6	11.1	9.3	7.6	69.4	58.4	47.6
Khon Kaen	5.2	4.1	3.3	11	9.2	7.6	69.0	57.4	47.7
Central									
Kanchanaburi	7.7	5.5	4.1	10	8.9	6.7	62.2	55.4	41.8
Nakhon Pathom	1.1	1	0.7	10.3	9.4	7.2	64.6	58.5	45.1
Prachuapkhi-rikhan	0.6	0.6	0.4	9.2	8.2	6	57.4	51.3	37.7

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.

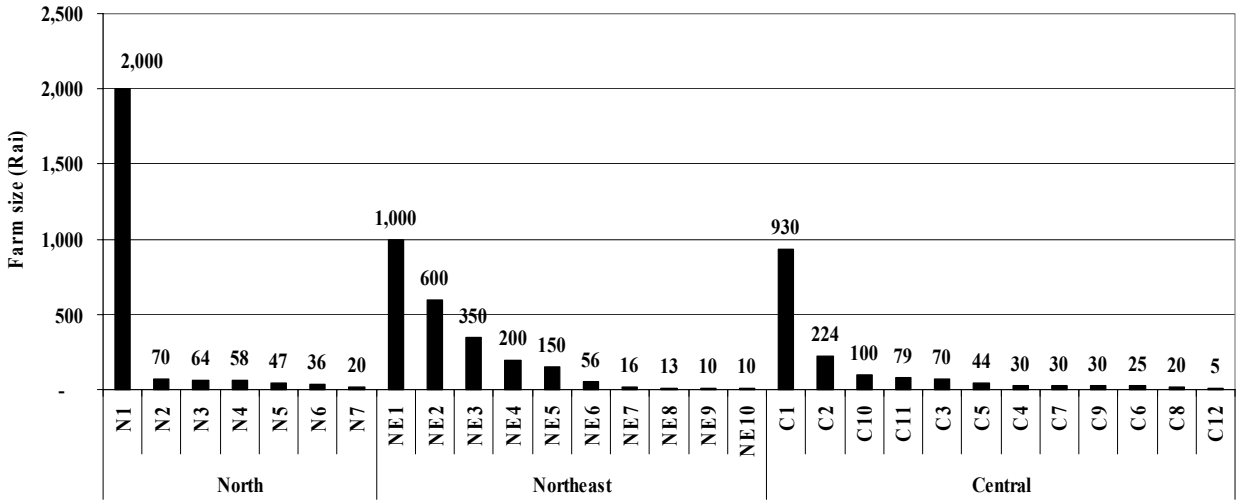
Farm size data can be summarized as follows (Figure 6.1 and appendix table 6.1):

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



Source: Own survey (2004).

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 6.2 Details of calculation of total production costs of sugarcane farms

	Details
Cash costs	**1.Variable Cost** 1.1 Labour Cost Soil preparation, soil improvement, breed preparation, planting, fertilizing, chemical application, watering, weeding, harvesting, 1.2 Factor Cost Breeding cost, fertilizer use, chemical use, watering cost, fuel and lubricant cost, management cost, maintenance cost, **2. Fixed Cost** Land use cost
Non cash costs	Depreciation and opportunity costs
Total costs	Cash costs + Non cash costs

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%.

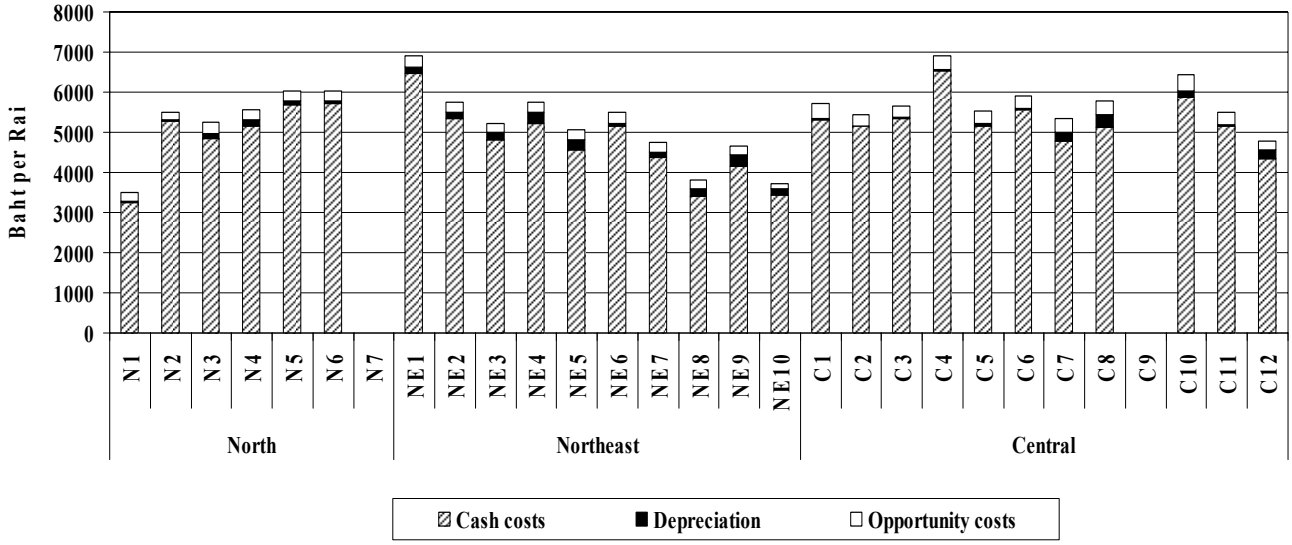
The total production costs of sugarcane farms for the first ratoon in the Northeast are lowest around 5,112 Baht per rai in the average compared to other regions. Low labor costs especially harvesting costs in the Northeast, of around 1,142 Baht per rai are the predominant reason for the lower cost structure. 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



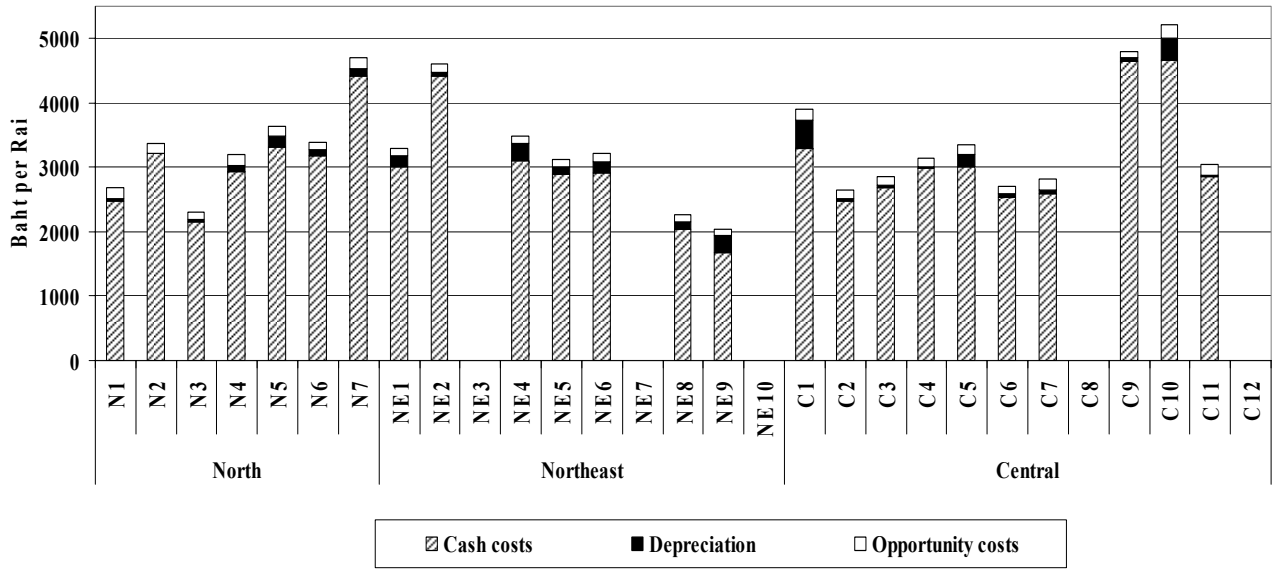
Source: Own survey (2004).

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



Source: Own survey (2004).

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

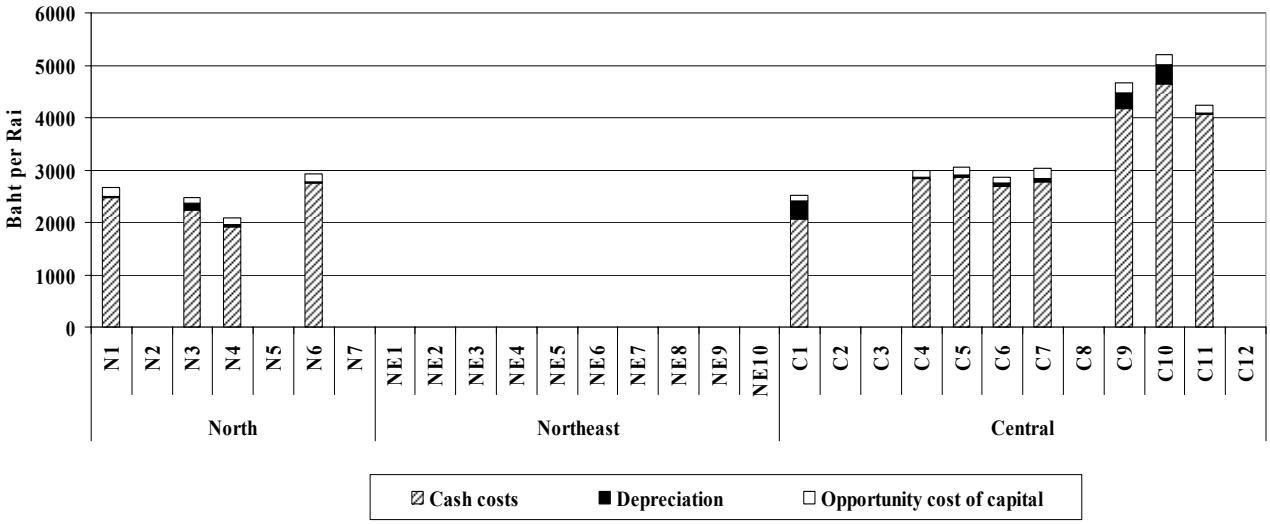
Farm code NE3, NE7, NE10, C8 and C12 had no sugarcane production for the second ratoon in production year 2003/04.

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 ratoons 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



Source: Own survey (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

Region	Unit	Total cost of sugarcane production			Average
		First ratoon	Second ratoon	Third ratoon	
North	(Baht/rai)	5,314	3,326	2,535	3,725
Northeast	(Baht/rai)	5,112	3,148	-	4,130
Central	(Baht/rai)	5,719	3,447	3,570	4,245
Average	(Baht/rai)	5,382	3,307	3,053	3,914

Source: Own survey (2004).

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 tons.
- 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

	Unit	Region	Ratoon			Average
			1	2	3	
Average yield	(Tons/Rai)	North	10.8	10.5	9.5	**10.3**
		Northeast	10.4	9.4	-	**9.9**
		Central	12.9	12.0	11.1	**12.0**
		Average	**11.4**	**10.6**	**10.3**	
Average price	(Baht/ton)	North	473.5	490.4	474.2	**479.3**
		Northeast	503.7	508.8	-	**506.3**
		Central	498.9	504.7	512.6	**505.4**
		Average	**492.0**	**501.3**	**493.4**	

Source: Own survey (2004).

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.

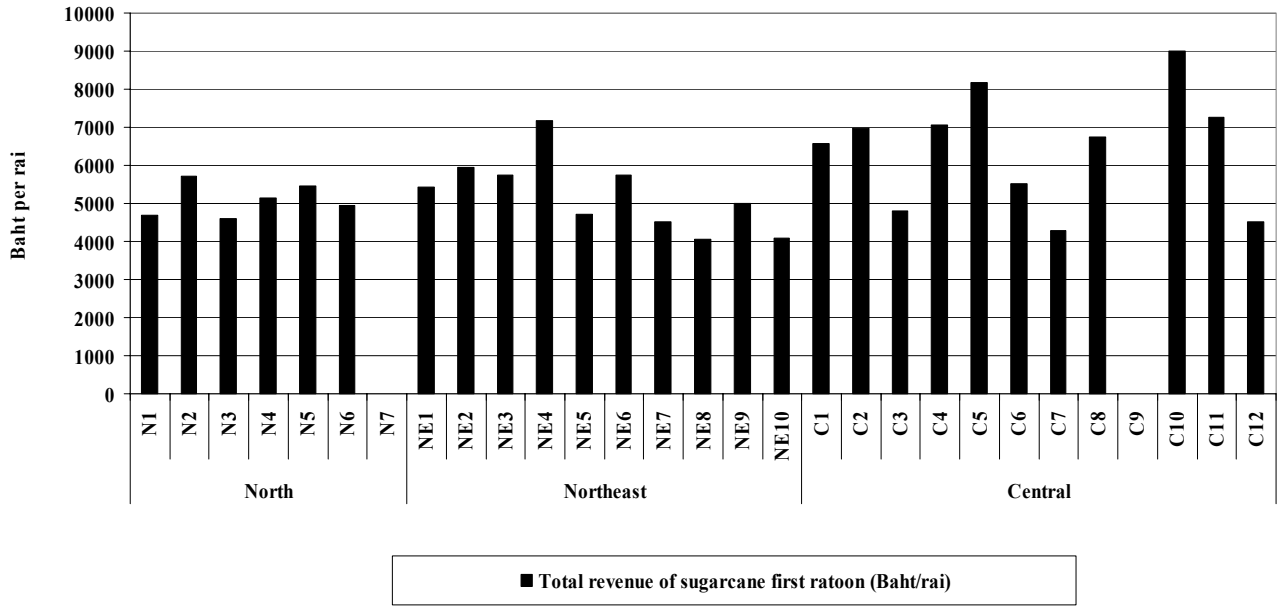
The preliminary sugarcane price is the price at a C.C.S. level of 10. The rate of change in sugarcane price (additional payment) was at 27.9 Baht per C.C.S. per metric tons in the production year 2003/04.

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

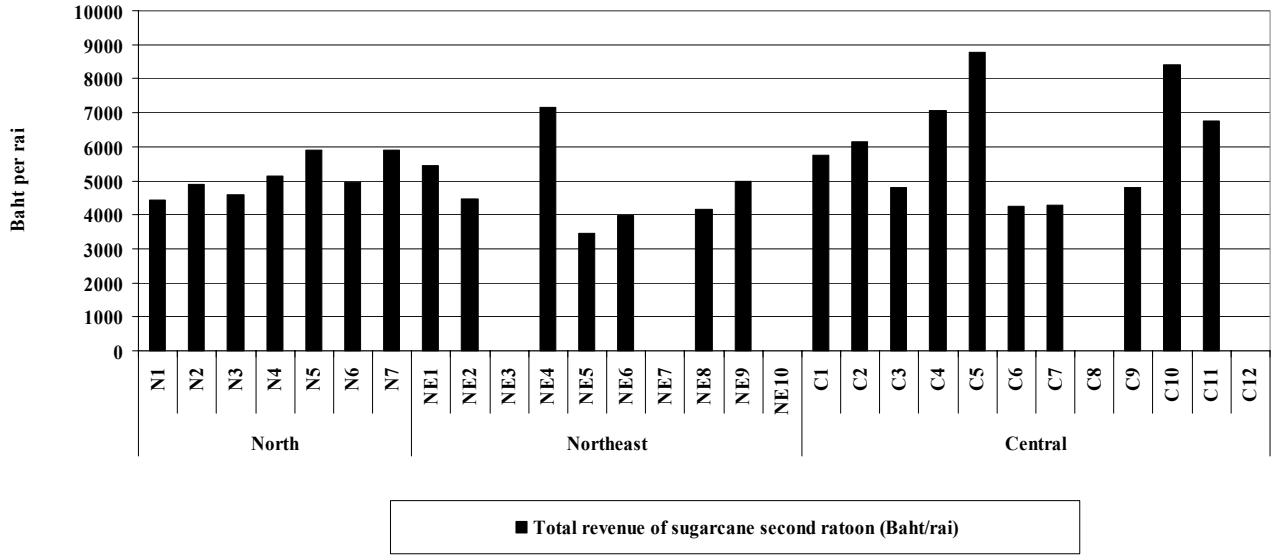


Source: Own survey (2004).

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



Source: Own survey (2004).

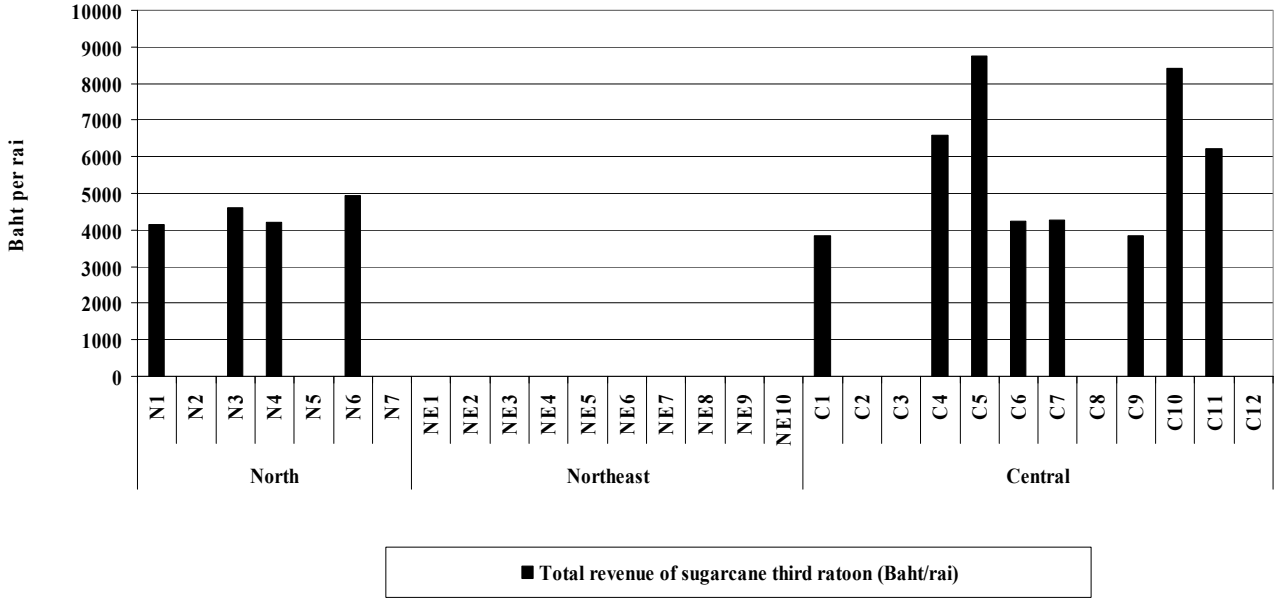
Note: Region code N-North, NE-Northeast, C-Central

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

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



Source: Own survey (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

Region	Unit	Total revenue of sugarcane production			Average
		First ratoon	Second ratoon	Third ratoon	
North	(Baht/rai)	5,091	5,118	4,478	4,896
Northeast	(Baht/rai)	5,236	4,804	-	5,020
Central	(Baht/rai)	6,441	6,100	5,771	6,104
Average	(Baht/rai)	5,589	5,341	5,125	5,340

Source: Own survey (2004).

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.

Economic profit = Accounting profit – Opportunity cost

= (Total revenue - Total variable cost - Total fixed cost)

- 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

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

Source: Own survey (2004).

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
  = 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:

$$Break-even\ yield = \frac{Total\ cost}{Output\ price}$$

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):

Total cost = **Cash cost** (variable cost+ fixed cost) +
Non cash cost (depreciation+ 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).

$$Break-even\ price = \frac{Total\ cost}{Expected\ yield}$$

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

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

Source: Own survey (2004).

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

			Region			
	Ratoon	Unit	North	Northeast	Central	**Average**
Average total revenue	1st	(Baht/rai)	5,091.0	5,236.0	6,441.0	**5,589.3**
	2nd	(Baht/rai)	5,118.0	4,804.0	6,100.0	**5,340.7**
	3rd	(Baht/rai)	4,478.0	-	5,771.0	**5,125.0**
	Average	(Baht/rai)	**4,895.7**	**5,020.0**	**6,104.0**	**4,782.1**
Average total variable costs	1st	(Baht/rai)	4,823.0	4,405.0	5,233.0	**4,820.3**
	2nd	(Baht/rai)	2,751.0	2,650.0	2,797.0	**2,732.7**
	3rd	(Baht/rai)	2,343.0	-	2,669.0	**2,506.0**
	Average	(Baht/rai)	**3,305.7**	**3,527.5**	**3,566.3**	**3,466.5**
-Average total labor costs	1st	(Baht/rai)	2,616.0	2,490.0	3,299.0	**2,801.7**
	2nd	(Baht/rai)	1,661.0	1,576.0	1,671.0	**1,636.0**
	3rd	(Baht/rai)	1,387.0	-	1,602.0	**1,494.5**
	Average	(Baht/rai)	**1,888.0**	**2,033.0**	**2,190.7**	**2,037.2**
-Average total factor costs	1st	(Baht/rai)	2,207.0	1,915.0	1,934.0	**2,018.7**
	2nd	(Baht/rai)	1,090.0	1,074.0	1,126.0	**1,096.7**
	3rd	(Baht/rai)	956.0	-	1,067.0	**1,011.5**
	Average	(Baht/rai)	**1,417.7**	**1,494.5**	**1,375.7**	**1,429.3**
Average gross margin	1st	(Baht/rai)	268.0	831.0	1,208.0	**769.0**
	2nd	(Baht/rai)	2,367.0	2,154.0	3,303.0	**2,608.0**
	3rd	(Baht/rai)	2,135.0	-	3,102.0	**2,618.5**
	Average	(Baht/rai)	**1,590.0**	**1,492.5**	**2,537.7**	**1,873.4**

Source: Own survey (2004).

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.

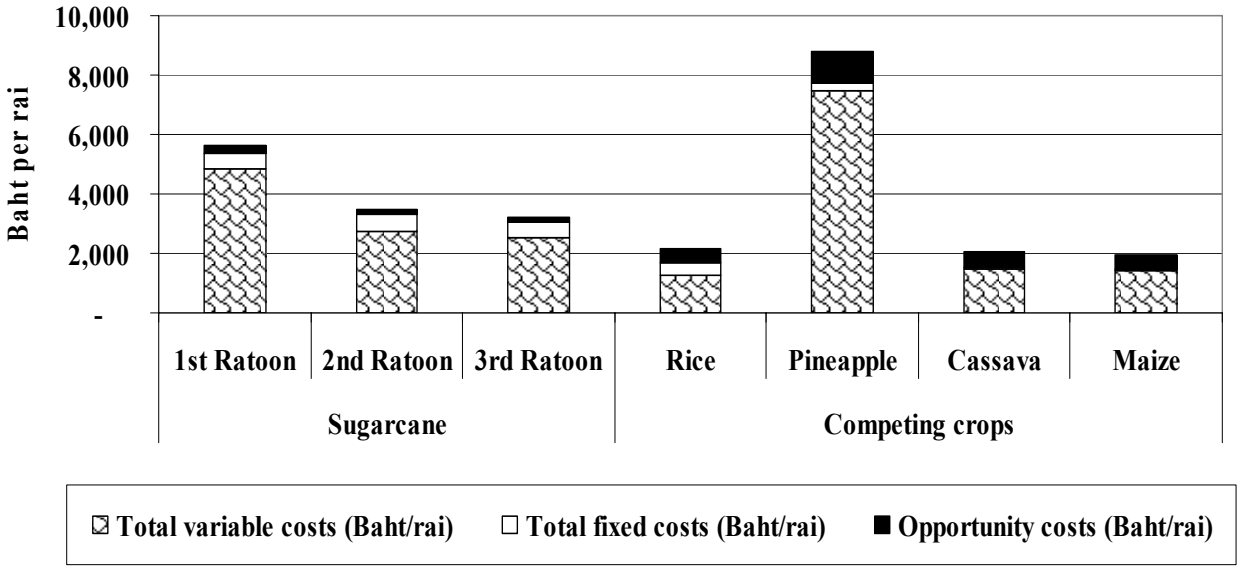
In most of the Lower Northeast, Upper Northeast, and some parts of the Lower North, farmers planted only one crop of maize per year during the early rainy season from April to June.

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.

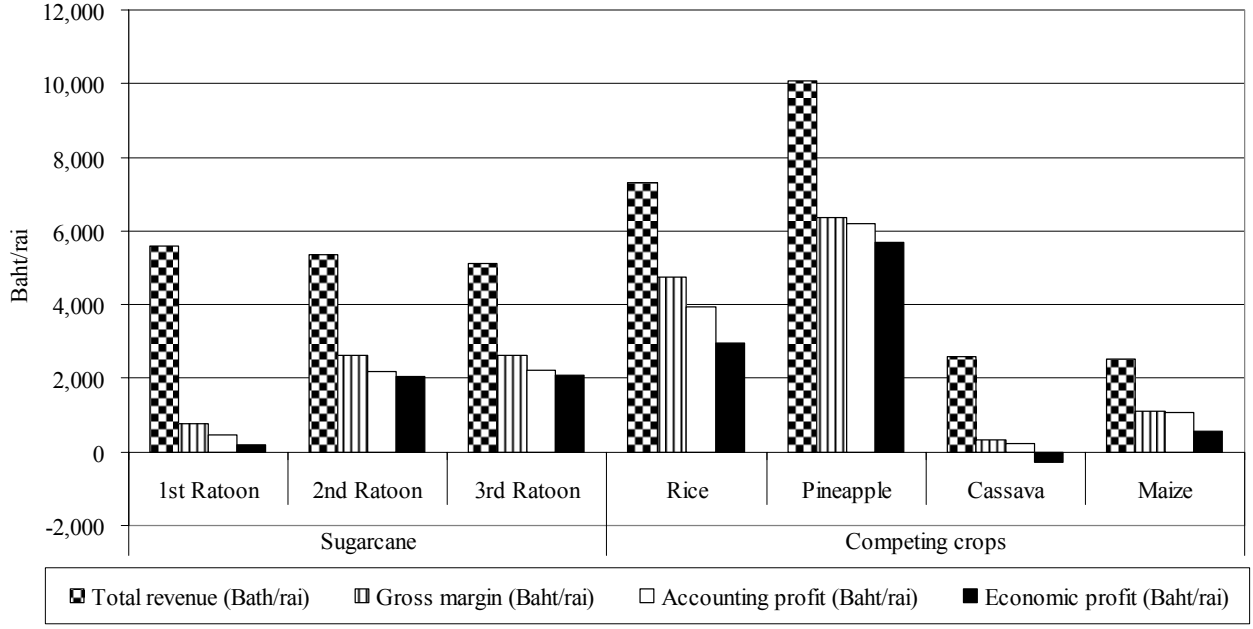
Figure 6.8 Comparison of total variable costs and total fixed costs of sugarcane and competing crops



Source: Own survey (2004).

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.

Figure 6.9 Comparison of total revenue, gross margin farm income and profit of sugarcane production and competing crops



Source: Own survey (2004).

The total revenue and profit was highest for pine apple, 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 forth 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

Items	Sugarcane			Average sugarcane
	Ratoon			
	1st	2nd	3rd	
Total revenue (Bath/rai)	5,589	5,341	5,125	5,352
Gross margin (Baht/rai)	769	2,608	2,619	1,999
Accounting profit (Baht/rai)	473	2,173	2,215	1,620
Economic profit (Baht/rai)	208	2,034	2,072	1,438
Ranking of economic profit				**3**

Items	Competing Crops (per year)			
	Rice (2 times/ year)	Pineapple (0.5 time/ year)	Cassava (1 times/ year)	Maize (1 times/ year)
Total revenue (Bath/rai)	7,300	10,083	2,600	2,528
Gross margin (Baht/rai)	4,750	6,350	320	1,106
Accounting profit (Baht/rai)	3,942	6,204	224	1,074
Economic profit (Baht/rai)	2,946	5,679	-276	579
Ranking of economic profit	**2**	**1**	**5**	**4**

Items	Competing Crops* (per one crop)			
	Rice	Pineapple	Cassava	Maize
Total revenue (Bath/rai)	3,650	20,167	2,600	2,528
Gross margin (Baht/rai)	2,375	12,699	320	1,106
Accounting profit (Baht/rai)	1,971	12,408	224	1,074
Economic profit (Baht/rai)	1,473	11,358	-276	579

Source: Own survey (2004).

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 7.1 Characteristics of the analyzed sugar factories

	Factory				
	Factory A	Factory B	Factory C	Factory D	Factory E
Size	Large	Small	Small	Small	Small
Region	North	North	Central	Central	Northeast
Average crushing capacity (Ton/day)	> 23,812	< 12,095	< 12,095	< 12,095	< 12,095
Number of sugarcane supplier	4,678	925	473	276	n.a.
Owner: Bank: Other enterprises: Other shareholder	6: 1: 80: 13	0: 0: 57: 43	100: 0: 0: 0	100: 0: 0: 0	n.a.

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

	Number of supplier					
Sugar Factory Size	Factory A (Large)	Factory B (Small)	Factory C (Small)	Factory D (Small)	Total	**Average**
Size of sugarcane supplier						
< 59 rai	3,416.00	573.00	267.00	53.00	4,310.00	**67.84**
Percent	73.02	61.95	56.45	19.20		
60-199 rai	1,043.00	279.00	206.00	153.00	1,681.00	**26.46**
Percent	22.30	30.16	43.55	55.43		
> 199 rai	219.00	73.00	0	70.00	362.00	**5.70**
Percent	4.68	7.89	0	25.36		
Total number of Sugarcane Suppliers	4,678.00	925.00	473.00	276.00	6,353.00	**100.00**

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 (%)

Size of sugarcane area suppliers	Share of sugarcane received (%)			
	Factory A	Factory B	Factory C	Factory D
(< 59 rai)	20.80	14.96	40.00	3.10
(60-199 rai)	26.89	35.43	60.00	35.63
(> 110 rai)	52.31	49.60		61.27

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 (%)

	Factory A	Factory B	Factory C	Factory D	Factory E
Share of total sales in monetary value, %					
Distribution of sugar production through:					
- Wholesale network	11-25%	> 76%	95%	-	-
- Sugar Export trader	51-75%	< 10%	-	-	-
- Company in branch	11-25%	-	-	-	-
- Domestic sales to food and beverage industry	-	11-25%	-	-	-
- Consumer market	-	-	5%	-	-

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

Source of sugarcane	Distance (Km.)				Average (Km.)
	Factory A	Factory B	Factory C	Factory D	
Private sugarcane farmers	50.00		40.00	70.00	53.33
Factory's sugarcane farms	17.50	30.00	60.00	20.00	31.88

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

	White sugar			Raw sugar	Total Sugar Production	Sugarcane Area
	Plantation white sugar (Kg/rai)	Refined sugar (Kg/rai)	Total (Kg/rai)	(Kg/rai)	(Kg/rai)	(Rai)
Production Year 2002/03						
Factory A	222	55	277	589	866	**522,842**
Factory B	242	277	519	352	872	**154,285**
Factory C	990	-	990	262	1,252	**73,822**
Factory D	338	208	546	133	679	**82,153**
Factory E	n/a	-	n/a	n/a	n/a	**n/a**
Average	448	180	583	334	917	
Production Year 2003/04						
Factory A	191	100	291	638	930	**544,413**
Factory B	383	8	390	647	1,038	**147,295**
Factory C	743	-	743	470	1,213	**68,442**
Factory D	395	114	509	277	787	**82,965**
Factory E	319	-	319	824	1,143	**100,630**
Average	406	74	451	571	1,022	

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

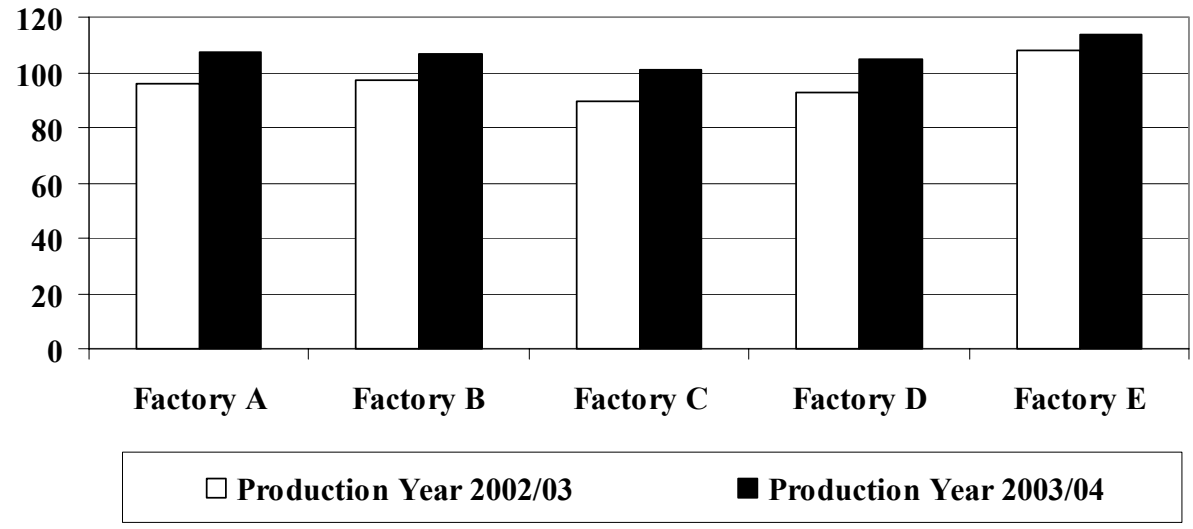
The average sugar extraction rate (ETR) in Thailand amounts to 100 kg of sugar per ton of sugarcane. Therefore, if there is sugarcane supply of 10 tons of one rai, the factory can produce 1,000 kg of sugar.

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

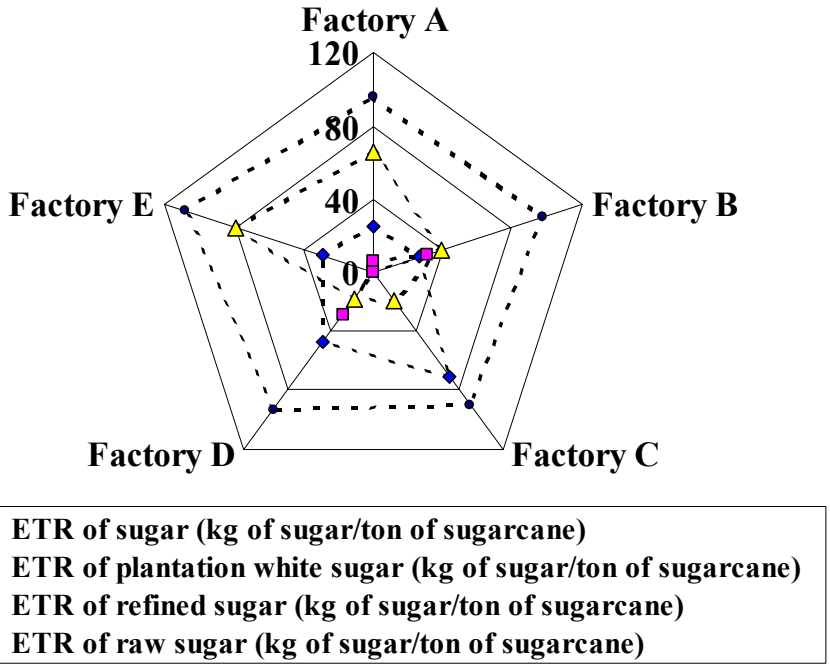
Figure 7.2 and 7.3 depict the ETR of sugar per ton of sugarcane in production year 2002/03 and 2003/04. The figures show the efficiency of sugar extraction of the investigated sugar factories as well as their production program concerning the type of sugar which is produced. In production year 2002/03, 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.

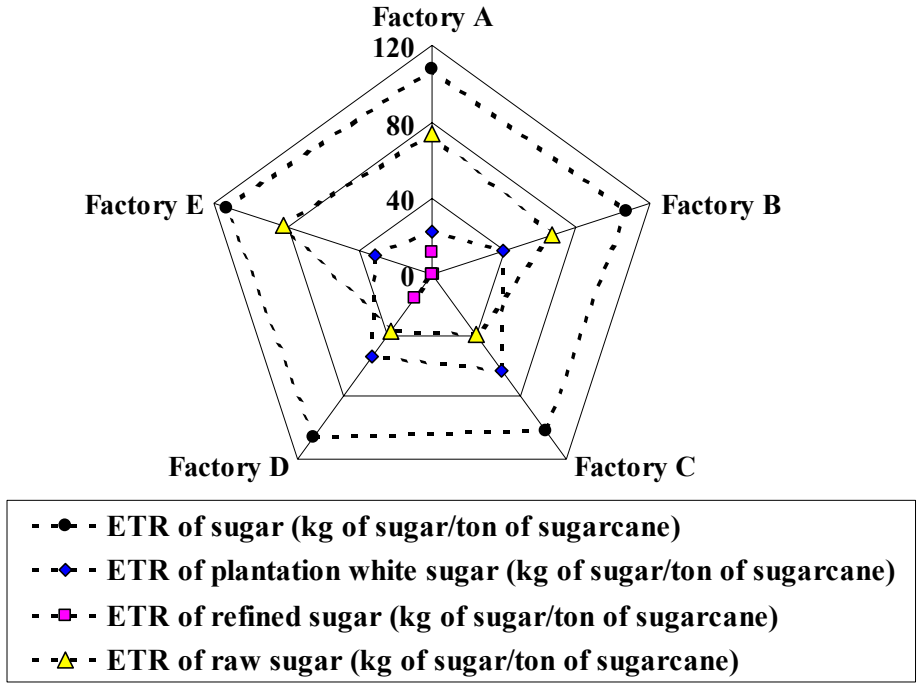
Moreover, factory C and E still produce plantation white sugar oriented, while factory E produce raw sugar oriented. The last interesting point is almost the entire sugar factory has lowest ETR of refined sugar, especially factory C and E did not produce refined sugar in both years. Similarly, factory 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.

Figure 7.3 Extraction rate of sugar (kg of sugar per ton of sugarcane) in production year 2003/04



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 sugar cane). 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

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

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

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

Source: Own survey (2004).

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)

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

Source: Own survey (2004).

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

	Profit of sugar production (Baht/kg)	**Profit of sugar production** (Baht/rai)
Production Year 2002/03		
Factory A	0.26	223.42
Factory B	0.62	539.97
Factory C	-0.59	-737.82
Factory D	0.57	386.58
Factory E	n.a	n.a
Average	**0.21**	**103.04**
Production Year 2003/04		
Factory A	0.27	246.72
Factory B	0.19	193.89
Factory C	-0.23	-275.38
Factory D	0.61	476.35
Factory E	1.40	1,599.34
Average	**0.45**	**448.19**

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

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

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 sulferdioxide. 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 subacefate. 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[14] 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 brining 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".

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

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

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

Level of expected problem	Factory A	Factory B	Factory C	Factory D	Factory E
Very high					
High	**x**	n.a.	**x**	**x**	
Medium					
Low					
Lowest					**x**

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 Prachuapkhirikhan 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

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)

Thailand ist inzwischen als eines der führenden Zuckerexportländer der Welt fest etabliert. Zwischen 1995/96 und 2005/06 bewegten sich die jährlichen Zuckerexporte zwischen 2,3 und 5,1 Mio. t und betrugen im Durchschnitt 3,8 Mio. t. Aus diesem Grund ist die Rohrzuckerproduktion einer der wichtigsten Wirtschaftssektoren in Thailand. Dabei sind verschiedene Bereiche wie z.B. der Zuckerrohranbau, die Zuckerindustrie, Banken zur Finanzierung sowie Transport- und Exportunternehmen an dem gesamten Produktionsprozess beteiligt. Die mit der Zuckererzeugung verbundenen Aktivitäten schaffen zahlreiche Arbeitsplätze und saisonale Beschäftigungsmöglichkeiten in den Zuckerfabriken, in der Zuckerverarbeitung sowie im Transport- und Exportbereich. Vor diesem Hintergrund ist die vorliegende Studie über die Wettbewerbsfähigkeit der Zuckerrohrproduktion und der Zuckerindustrie in Thailand von großer Bedeutung, insbesondere im Rahmen der zunehmenden Liberalisierung des Weltmarktes.

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.
2. Kosten und Erlöse des Zuckerrohranbaus und der Zuckererzeugung in Thailand zu analysieren.
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.

Diese Studie konzentriert auf den Vergleich der Kosten und Erlöse von Zuckerrohr und seinen Konkurrenzfrüchten in Thailand. Feldstudien und Befragungen wurden mit Akteuren im Bereich der Zuckererzeugung durchgeführt. Zusätzliche Sekundärdaten wurden einbezogen, um die Forschung ergänzen.

Die angewandte Methode zur Stichprobenauswahl basiert auf dem Konzept des typischen Betriebes („typical farm approach“). Die zu betrachtenden Betriebstypen wurden von Zuckerrohrexperten 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.

Die Daten, die in dieser Studie verwendet wurden, bestehen aus Primär- und Sekundärdaten. Die Primärdaten wurden mithilfe von Befragungen gesammelt, die bei Zuckerrohranbauern und in Zuckerfabriken durchgeführt wurden. Die Daten wurden für das Erntejahr 2003/04 erhoben. Mit dem Betriebsfragebogen wurden Informationen über die Betriebsstruktur, die Maschinen- und Gebäudekapazität, die Arbeitsorganisation, Faktorkosten und Erlöse der Zuckerrohrproduktion, die Wirtschaftlichkeit von Konkurrenzfrüchten, Beregnungsmethoden sowie künftige Betriebsentwicklungsstrategien gesammelt. Mit dem Fragebogen für die Zuckerfabriken wurden Daten über das jeweilige Unternehmensprofil, Kosten des Zuckerrohrtransportes vom Feld zum Fabriktor, Verarbeitungskosten der Fabriken, relevante Umweltregelungen und die künftigen Entwicklungsstrategien der Zuckerfabriken gesammelt. Die Sekundärdaten haben den Zweck, die Wettbewerbsfähigkeit der gesamten Zuckerindustrie in Thailand zu analysieren. Sie stammen von Quellen wie dem Büro des Zuckerrohr- und Zuckerausschusses (OCSB), dem Büro der Agrarwirtschaft (OAE), der Vereinigung der Zuckerindustrie sowie der Vereinigung der Zuckerrohranbauer, Zuckerfabriken, und Zuckerhändler. Die Sekundärdaten stammen aus den Jahren 1982 bis 2006.

Diese Forschungsarbeit wurde in der Zentralregion, der Nordostregion und der Nordregion Thailands durchgeführt. Das Untersuchungsgebiet besteht aus neun Provinzen in drei Regionen. Es sind drei Provinzen in der Nordostregion (Khon Kaen, Burirum und Udonthani Provinz), zwei Provinzen in der Nordregion (Nakhon Sawan und Phitsanulok Provinz) und es sind vier Provinzen in der Zentralregion (Kanchanaburi, Nakhon Pathom, Bangkok und Prachuapkhirikhan Provinz).

Mit dem Betriebsfragebogen wurden Daten von Zuckerrohranbauern in der Nord-, der Zentral- und der Nordostregion gesammelt. Die Zufallsstichprobe besteht aus 29 Zuckerrohrbetrieben: 7 Betriebe im Norden, 10 Betriebe in Zentralthailand und 12 Betriebe im Nordosten. Mit dem zweiten Fragebogen wurden Daten von Zuckerfabriken in denselben Regionen erhoben. Die Fabrikfragebögen wurden an alle 46 Zuckerfabriken in Thailand verschickt, von denen jedoch nur fünf antworteten. Unter diesen waren eine große und vier kleine Fabriken.

Erstens kann die Struktur der Zuckerrohrproduktion in Thailand wie folgt beschrieben werden. Zuckerrohr wird in ganz Thailand angebaut. Die gesamte Zuckerrohranbaufläche betrug 6,34 Mio. rai im Jahr 2004/05. Die wichtigsten Zuckerrohranbaugebiete sind der Nordosten, Zentralthailand und die nördlichen Region. Die gesamte Zuckerrohrerzeugung betrug 47,82 Mio. t im Jahr 2004/05

bei einem durchschnittlichen Ertrag von 7,54 t/rai. Mehr als 80 % aller Zuckerrohranbauer in Thailand (174326) sind kleine Anbauer mit einer Zuckerrohrfläche von weniger als 59 rai. 87 % der Zuckerrohranbauer produzieren unter natürlichen Niederschlagsbedingungen, nur 13% der Betriebe bewässern ihre Zuckerrohrfläche. Bewässerung wird vor allem in der Zentralregion eingesetzt, wo 27 % der Zuckerrohranbauer ihre Zuckerrohrfläche bewässern. Das Pflanzen von Zuckerrohr beginnt im Oktober und ist bis Mai möglich. Die Ernteperiode reicht von Dezember bis April. Die Nutzungsdauer einer Zuckerrohranlage beträgt in der Regel zwei bis drei Ernten.

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).

Drittens kann der Zuckermarkt in Thailand wie folgt beschrieben werden. Im Jahr 2003/04 betrug die gesamte Zuckerproduktion rund 7 Mio. t. Bei einem Anteil des Inlandsverbrauchs von 27,8 % werden nur rund 2 Mio. t Zucker im Inland verbraucht. Der Rest von rund 5 Mio. t Zucker wird auf den Weltmarkt exportiert, vor allem nach Asien. Die Großhandelspreise für den Inlandsmarkt werden jährlich staatlich festgesetzt und liegen durchschnittlich bei rund 12 Baht/kg.

Viertens können die Befragungsergebnisse der Zuckerrohrbetriebe wie folgt beschrieben werden. Die Analyse der **Produktionskosten** hat gezeigt, dass die Produktionskosten von Zuckerrohr im ersten Jahr am höchsten sind und in den Folgejahren zurückgehen. Die Betriebe in der Zentralregion haben höhere durchschnittliche Produktionskosten (4245 Baht/rai) als die Zuckerrohranbauer im Nordosten (4130 Baht/rai) und im Norden (3725 Baht/rai). Geringe Arbeitskosten, insbesondere Erntekosten von rund 1142 Baht/rai, sind die Hauptgründe für die niedrigeren Kosten der Betriebe in der Nordostregion.

Die Analyse der **Gesamterlöse** in der Zuckerrohrproduktion hat gezeigt, dass mit der ersten Ernte die höchsten Erlöse erzielt werden (5589 Baht/rai), die zusammen mit dem Ertrag in den Folgeernten, insbesondere im dritten Jahr zurückgehen. Dies könnte für Betriebe in der Nordostregion der Grund sein, die Zuckerrohranlagen nur zwei Ernten zu nutzen. Die höchsten Erlöse im Durchschnitt über alle drei Ernten werden in der Zentralregion erzielt.

Die **Rentabilitätsanalyse** der Zuckerrohrproduktion hat gezeigt, dass der Gesamtgewinn im Durchschnitt aller Regionen im zweiten und dritten Jahr mit jeweils über 2000 Baht/rai am höchsten ist, während im ersten Jahr aufgrund der höheren Produktionskosten nur ein Gewinn von rund 200 Baht/rai erzielt wird. Betrachtet man den durchschnittlichen Gewinn über alle Jahre nach Regionen, zeigt sich, dass der Zuckerrohranbau in der Zentralregion den höchsten Gewinn liefert (1859 Baht/rai), gefolgt von der Nordregion (1171 Baht/rai) und der Nordostregion (890 Baht/rai).

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 Bresk-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.

Der Vergleich der **Deckungsbeiträge** in der Zuckerrohrproduktion hat gezeigt, dass der durchschnittliche Deckungsbeitrag einer Zuckerrohrplantage im ersten Jahr mit 769 Baht/rai viel geringer ist als in den Folgejahren mit jeweils rund 2600 Bhat/rai im zweiten und dritten Jahr. Im Hinblick auf Regionen erzielten die Zuckerrohranbauer in der Zentralregion im Jahr 2003/04 mit 2538 Baht/rai die höchsten durchschnittlichen Deckungsbeiträge, während die Zuckerrohranbauer im Norden und Nordosten nur 1590 bzw. 1493 Baht/rai erzielten.

Der Vergleich der Zuckerrohrproduktion mit dem Anbau von **Konkurrenzfrüchten** hat gezeigt, dass die wichtigsten Konkurrenzfrüchte von Zuckerrohr Reis, Ananas, Maniok und Mais sind. Das Zuckerrohr ist jedoch für die Zuckerrohrbetriebe in Thailand weiterhin eine Hauptfrucht. Aufgrund natürlicher und Marktbedingungen konkurrieren die betrachteten Alternativfrüchte nur teilweise mit dem Zuckerrohranbau. Reis kann nur in der Ebene angebaut werden und benötigt sehr viel Wasser. Ananas kann nur in wenigen Provinzen angebaut werden. Der Anbau von Maniok kann zu Bodenproblemen führen und ist weniger rentabel. Die Maispreise bieten Zuckerrohranbauern nur einen geringen Anreiz zum Wechsel von Zuckerrohr- zu Maisanbau. Vor diesem Hintergrund ist zu erwarten, dass Zuckerrohr weiterhin eine wichtige Rolle spielt und mit anderen Früchten konkurrieren kann.

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

angelieferten Zuckerrohrs aus mittleren und großen Zuckerrohrbetrieben. Die **Zuckererlöse** hängen von der jeweiligen Zucker- und Vermarktungsart ab und liegen bei den befragten Fabriken zwischen 14 zund 18 Baht/kg. Die durchschnittliche **Entfernung des Zuckerrohrtransports** liegt bei rund 53 km. Dies gilt für Zuckerrohr, das von fremden Anbauern gekauft wird. Die Transportentfernung für das fabrikeigene Zuckerrohr ist in der Regel niedriger. Je näher die Zuckerrohrfelder bei der Zuckerfabrik liegen, um so höher ist die Wettbewerbsfähigkeit der Zuckerfabrik.

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.

Bei der Analyse von **Problemen und Schwierigkeiten** der Zuckerindustrie wurde zwischen ökonomischen Problemen, Verarbeitungsproblemen, Marktproblemen, staatlichen Auflagen und Managementproblemen unterschieden. Viele Fabriken erwarten künftig viele verschiedene Probleme. Die zentralen ökonomischen Probleme, die genannt wurden, sind Geldmangel, Unsicherheit über wirtschaftliche Rahmenbedingungen und niedrige Zuckerpreise. Hinsichtlich Verarbeitungsproblemen befürchten die Fabriken mangelnde Rohstoffverfügbarkeit, steigende Inputkosten, Energiekosten und Produktionskosten. Als Marktprobleme werden sinkende Marktanteile durch inländischen und ausländischen Wettbewerb sowie durch Zuckersubstitute genannt. Zwei Fabriken erwarten künftig Schwierigkeiten durch staatliche

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

Schließlich liefert diese Studie Vorschläge und Politikempfehlungen zur Verbesserung der Wettbewerbsfähigkeit der Zuckerrohrbetriebe und Zuckerfabriken in vier Bereichen. Erstens sind Forschungs- und Entwicklungsaktivitäten im Bereich der Optimierung des Produktionsprozesses und der Züchtung neuer Zuckerrohrsorten erforderlich, da die Produktivität der Zuckerrohrproduktion in Thailand immer noch niedrig ist. Zweitens sollten den Betrieben mit staatlicher Unterstützung Bewässerungsmöglichkeiten zur Verfügung gestellt werden, da genügend Wasser und Zugang zu Bewässerungssystemen für den Zuckerrohranbau sehr wichtig sind. Drittens sollte die Zuckerindustrie ihre Produktpalette zur Steigerung der Wertschöpfung differenzieren. Dadurch können die Zuckerfabriken einer Situation niedriger Zuckerpreise begegnen. Viertens sollten die Zuckerfabriken aufgrund steigender Energiekosten Unterstützung durch Forschung und Entwicklung bei der Nutzung alternativer Energien und der Reduzierung ihrer Produktionskosten erhalten.

APPENDIX

Appendix to chapter 5

Appendix-Table 5.1: Recommended varieties of Thai sugarcane

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

Appendix-Table 5.1: Recommended varieties of Thai sugarcane (Continue)

Variety(parentage)	Description	Recommendation	Year released
Phil 66-07 or Marcos 3 (Phil 54-60 x Co 440)	- Yield (80 t/ha) - Medium CCS (10-12) - Good tillering - Good rationing - Drought tolerance - Harvesting age 11-12 months	- Loam soil - Loamy sand soil - Northeast region	-Introduced varieties
Phil 58-260 (Q 47 x POJ 3016)	- Yield (80 t/ha) - CCS (10-14) - Good tillering - Non-flowering - Medium drought tolerance - Harvesting age 11-12 months	- Loamy sand soil - Clay loam soil - Northeast region	-Introduced varieties

Source: BizDimension (2006).

Appendix to chapter 6

Appendix-Table 6.1: Structure of the sample farms

Farm	Total agri-cultural area (rai)	Sugarcane area (rai)	Ratoons (number)	Other crops (area) rice (rai)	cassava (rai)	pineapple (rai)	corn (rai)
N1	2500	2000	3	0	0	0	0
N2	95	70	2	25	0	0	0
N3	94	64	3	30	0	0	0
N4	58	58	3	0	0	0	0
N5	58	47	2	0	0	0	0
N6	46	36	3	6	0	0	0
N7	20	20	1	0	0	0	0
NE1	1000	1000	2	0	0	0	0
NE2	600	600	2	0	0	0	0
NE3	350	350	1	0	0	0	0
NE4	200	200	2	0	0	0	0
NE5	200	150	2	0	0	0	0
NE6	75	56	2	0	0	0	0
NE7	26	16	1	0	0	0	0
NE8	13	13	2	0	0	0	0
NE9	20	10	2	0	6	0	0
NE10	40	10	1	30	0	0	0
C1	1350	930	3	0	0	350	0
C2	290	224	2	0	0	40	0
C3	300	70	2	0	0	50	0
C4	50	30	3	0	0	0	2
C5	55	44	3	4	0	0	7
C6	30	25	3	0	0	0	4
C7	30	30	3	0	0	0	0
C8	20	20	1	0	0	0	0
C9	38	30	2	1	0	0	8
C10	100	100	3	0	0	0	0
C11	82	79	3	0	0	0	0
C12	5	5	1	0	0	0	0
North	**410**	**328**	**2.4**				
Northeast	**252**	**241**	**1.7**				
Central	**196**	**132**	**2.4**				
Total	286	234	2.2				

Source: Own survey (2004)

Appendix-Table 6.2: Total cost of sugarcane farms for the first ratoon

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

Source: Own survey (2004)

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

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

Source: Own survey (2004)

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

	Northeast				Average
	NE7	NE8	NE9	NE10	
Cash cost					
1.Variable cost (Baht/rai)					
1.1 Labour cost (Baht/rai)					
A. Soil Preparation	490	450	480	-	
B. Soil improvement	-	-	-	-	
C. Breed preparation	255	-	-	-	
D. Planting	150	238	500	160	
E. Fertilizing	25	25	30	30	
F. Chemical application	100	100	100	100	
G. Watering	-	-	-	-	
H. Weeding	360	120	48	200	
I. Harvesting	1,020	1,113	960	1,135	
1.2 Factor cost (Baht/rai)					
A. Breeding cost	1,000	500	675	478	
B. Fertilizer use	820	700	720	1,040	
C. Chemical use	142	23	75	145	
D. Watering cost	-	-	-	-	
E. Fuel and lubricant cost	-	46	16	115	
F. Management cost	-	-	-	29	
G.Maintenance Cost	13	92	45	15	
2. Fixed cost (Baht/rai)					
Land use cost	-	-	500	-	
Total cash costs (Baht/rai)	4,375	3,406	4,149	3,448	4,694
Total cash costs (Baht/ton)	486	470	415	383	453
Non cash cost					
Depreciation	111	188	281	140	
Opportunity cost of capital	263	207	227	144	
Total non cash costs (Baht/rai)	374	395	509	284	418
Total non cash costs (Baht/ton)	42	54	51	32	41
Total cost					
Total Cost/rai (Bath/rai)	4,749	3,801	4,658	3,731	**5,112**
Total Cost/ton (Bath/ton)	528	524	466	415	**498**
Yield per rai (Tons/rai)	9	7	10	9	**10.4**
Cane price (Baht/ton)	500	560	500	453	**503.7**
Total revenue (Baht/rai)	4,500	4,060	5,000	4,076	**5,236**
Accounting profit (Baht/rai)	14	466	570	489	**361**
Economic profit (Baht/rai)	-249	259	342	345	**124**

Source: Own survey (2004)

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

	Central					
	C1	C2	C3	C4	C5	C6
Cash cost						
1.Variable cost (Baht/rai)						
1.1 Labour cost (Baht/rai)						
A. Soil Preparation	644	1,090	746	1,100	500	1,230
B. Soil improvement	-	-	-	-	-	-
C. Breed preparation	250	600	310	-	-	-
D. Planting	316	-	256	1,200	600	650
E. Fertilizing	15	25	60	25	25	100
F. Chemical application	58	47	120	110	231	60
G. Watering	-	-	-	-	20	-
H. Weeding	260	384	320	240	200	160
I. Harvesting	1,680	1,350	1,400	1,500	1,615	1,126
1.2 Factor cost (Baht/rai)						
A. Breeding cost	650	471	638	881	600	1,000
B. Fertilizer use	860	1,080	-	1,000	520	1,040
C. Chemical use	485	83	40	140	400	160
D. Watering cost	-	-	-	27	169	-
E. Fuel and lubricant cost	96	-	1,000	19	160	15
F. Management cost	-	-	-	-	65	18
G.Maintenance Cost	0	10	-	-	42	-
2. Fixed cost (Baht/rai)						
Land use cost	-	-	460	300	-	-
Total cash costs (Baht/rai)	5,314	5,141	5,350	6,542	5,147	5,558
Total cash costs (Baht/ton)	443	343	535	436	303	556
Non cash cost						
Depreciation	42	2	17	5	72	33
Opportunity cost of capital	359	285	275	366	296	311
Total non cash costs (Baht/rai)	401	286	293	370	368	344
Total non cash costs (Baht/ton)	33	19	29	25	22	34
Total cost						
Total Cost/rai (Bath/rai)	5,714	5,427	5,642	6,913	5,516	5,902
Total Cost/ton (Bath/ton)	476	362	564	461	324	590
Yield per rai (Tons/rai)	12	15	10	15	17	10
Cane price (Baht/ton)	548	465	481	470	480	550
Total revenue (Baht/rai)	6,572	6,975	4,808	7,050	8,160	5,500
Accounting profit (Baht/rai)	1,217	1,833	-559	503	2,941	-91
Economic profit (Baht/rai)	858	1,548	-834	137	2,644	-402

Source: Own survey (2004)

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

	Central						Average
	C7	C8	C9	C10	C11	C12	
Cash cost							
1.Variable cost (Baht/rai)							
1.1 Labour cost (Baht/rai)							
A. Soil Preparation	850	850	-	500	500	-	
B. Soil improvement	-	-	-	-	-	-	
C. Breed preparation	-	-	-	-	-	-	
D. Planting	615	600	-	700	800	500	
E. Fertilizing	40	20	-	20	-	40	
F. Chemical application	128	60	-	105	200	240	
G. Watering	-	-	-	180	150	480	
H. Weeding	-	160	-	352	150	390	
I. Harvesting	1,260	1,500	-	1,575	1,400	1,300	
1.2 Factor cost (Baht/rai)							
A. Breeding cost	478	844	-	1,000	1,000	-	
B. Fertilizer use	1,120	580	-	1,000	360	800	
C. Chemical use	210	198	-	317	307	140	
D. Watering cost	-	300	-	-	-	-	
E. Fuel and lubricant cost	-	-	-	96	149	236	
F. Management cost	-	-	-	19	134	34	
G.Maintenance Cost	80	-	-	-	15	192	
2. Fixed cost (Baht/rai)							
Land use cost	-	-	-	-	-	-	
Total cash costs (Baht/rai)	4,781	5,112	-	5,864	5,165	4,352	5,302
Total cash costs (Baht/ton)	531	341	-	391	369	435	426
Non cash cost							
Depreciation	229	329	-	177	12	210	
Opportunity cost of capital	324	330	-	387	310	213	
Total non cash costs (Baht/rai)	553	658	-	564	323	423	417
Total non cash costs (Baht/ton)	61	44	-	38	23	42	34
Total cost							
Total Cost/rai (Bath/rai)	5,334	5,770	-	6,428	5,488	4,775	**5,719**
Total Cost/ton (Bath/ton)	593	385	-	429	392	477	**459**
Yield per rai (Tons/rai)	9	15	-	15	14	10	**12.9**
Cane price (Baht/ton)	475	450		600	519	450	**498.9**
Total revenue (Baht/rai)	4,275	6,750	-	9,000	7,266	4,500	**6,441**
Accounting profit (Baht/rai)	-735	1,310	-	2,959	2,089	-62	**1,037**
Economic profit (Baht/rai)	-1,059	980	-	2,572	1,778	-275	**723**

Source: Own survey (2004)

Appendix-Table 6.3: Total cost of sugarcane farms for the second ratoon

	North							Average
	N1	N2	N3	N4	N5	N6	N7	
Cash cost								
1.Variable cost (Baht/rai)								
1.1 Labour cost (Baht/rai)								
A. Soil Preparation	-	-	-	-	-	-	-	
B. Soil improvement	-	-	-	100	-	-	5	
C. Breed preparation	-	-	-	-	-	-	-	
D. Planting	-	-	-	-	-	-	-	
E. Fertilizing	210	200	20	60	130	130	60	
F. Chemical application	100	120	40	70	-	-	120	
G. Watering	16	-	8	83	-	-	72	
H. Weeding	130	480	-	248	-	-	132	
I. Harvesting	1,105	1,300	1,100	1,687	1,200	1,320	1,380	
1.2 Factor cost (Baht/rai)								
A. Breeding cost	-	-	-	-	-	-	900	
B. Fertilizer use	676	743	743	375	850	818	818	
C. Chemical use	170	296	175	166	-	-	50	
D. Watering cost	-	-	-	-	-	-	-	
E. Fuel and lubricant cost	45	47	25	57	284	86	50	
F. Management cost	19	10	12	10	25	17	20	
G.Maintenance Cost	8	14	26	75	13	-	-	
2. Fixed cost (Baht/rai)								
Land use cost	-	-	-	-	800	800	800	
Total cash costs (Baht/rai)	2,480	3,210	2,150	2,931	3,303	3,171	4,407	3,093
Total cash costs (Baht/ton)	292	321	215	266	254	288	441	297
Non cash cost								
Depreciation	42	4	42	88	175	109	120	
Opportunity cost of capital	160	155	119	181	154	105	175	
Total non cash costs (Baht/rai)	202	160	161	269	329	215	296	233
Total non cash costs (Baht/ton)	24	16	16	24	25	20	30	22
Total cost								
Total Cost/rai (Bath/rai)	2,682	3,370	2,311	3,200	3,632	3,386	4,703	**3,326**
Total Cost/ton (Bath/ton)	316	288	231	291	303	308	470	**315**
Yield per rai (Tons/rai)	9	10	10	11	13	11	10	**10.5**
Cane price (Baht/ton)	520	489	460	467	455	450	592	**490.4**
Total revenue (Baht/rai)	4,420	4,892	4,599	5,135	5,915	4,950	5,916	**5,118**
Accounting profit (Baht/rai)	1,898	1,677	2,406	2,117	2,437	1,669	1,338	**1,942**
Economic profit (Baht/rai)	1,738	1,522	2,288	1,936	2,283	1,564	1,213	**1,792**

Source: Own survey (2004)

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

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

Source: Own survey (2004)

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

	Northeast				Average
	NE7	NE8	NE9	NE10	
Cash cost					
1.Variable cost (Baht/rai)					
1.1 Labour cost (Baht/rai)					
A. Soil Preparation	-	-	-	-	
B. Soil improvement	-	-	-	-	
C. Breed preparation	-	-	-	-	
D. Planting	-	-	-	-	
E. Fertilizing	-	25	40	-	
F. Chemical application	-	100	-	-	
G. Watering	-	-	-	-	
H. Weeding	-	-	-	-	
I. Harvesting	-	1,108	760	-	
1.2 Factor cost (Baht/rai)					
A. Breeding cost	-	-	-	-	
B. Fertilizer use	-	350	720	-	
C. Chemical use	-	30	75	-	
D. Watering cost	-	-	-	-	
E. Fuel and lubricant cost	-	46	16	-	
F. Management cost	-	10	10	-	
G.Maintenance Cost	-	62	45	-	
2. Fixed cost (Baht/rai)					
Land use cost	-	300	-	-	
Total cash costs (Baht/rai)	-	2,030	1,666	-	2,857
Total cash costs (Baht/ton)	-	274	167	-	314
Non cash cost					
Depreciation	-	125	281	-	
Opportunity cost of capital	-	112	94	-	
Total non cash costs (Baht/rai)	-	237	375	-	291
Total non cash costs (Baht/ton)	-	32	38	-	31
Total cost					
Total Cost/rai (Bath/rai)	-	2,268	2,041	-	**3,148**
Total Cost/ton (Bath/ton)	-	313	204	-	**299**
Yield per rai (Tons/rai)		7	10		**9.4**
Cane price (Baht/ton)	-	560	500	-	**508.8**
Total revenue (Baht/rai)	-	4,144	5,000	-	**4,804**
Accounting profit (Baht/rai)	-	1,988	3,053	-	**1,775**
Economic profit (Baht/rai)	-	1,876	2,959	-	**1,656**

Source: Own survey (2004)

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

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

Source: Own survey (2004)

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

	Central						Average
	C7	C8	C9	C10	C11	C12	
Cash cost							
1.Variable cost (Baht/rai)							
1.1 Labour cost (Baht/rai)							
A. Soil Preparation	-	-	-	-	-	-	
B. Soil improvement	-	-	-	-	-	-	
C. Breed preparation	-	-	-	-	-	-	
D. Planting	-	-	-	-	-	-	
E. Fertilizing	40	-	120	20	33	-	
F. Chemical application	64	-	180	53	200	-	
G. Watering	-	-	120	120	67	-	
H. Weeding	-	-	-	144	122	-	
I. Harvesting	1,260	-	1,700	1,470	1,300	-	
1.2 Factor cost (Baht/rai)							
A. Breeding cost	-	-	-	-	-	-	
B. Fertilizer use	1,120	-	1,120	1,000	600	-	
C. Chemical use	70	-	-	210	107	-	
D. Watering cost	-	-	-	-	-	-	
E. Fuel and lubricant cost	-	-	360	120	210	-	
F. Management cost	10	-	30	19	196	-	
G.Maintenance Cost	20	-	10	-	25	-	
2. Fixed cost (Baht/rai)							
Land use cost	-	-	1,000	1,500	-	-	
Total cash costs (Baht/rai)	2,584	-	4,640	4,656	2,860	-	**3,173**
Total cash costs (Baht/ton)	287	-	464	333	220	-	**273**
Non cash cost							
Depreciation	57	-	60	354	20	-	
Opportunity cost of capital	173	-	98	205	172	-	
Total non cash costs (Baht/rai)	230	-	158	559	193	-	**275**
Total non cash costs (Baht/ton)	26	-	16	40	15	-	**23**
Total cost							
Total Cost/rai (Bath/rai)	2,814	-	4,798	5,214	3,053	-	**3,447**
Total Cost/ton (Bath/ton)	313	-	-	348	235	-	**236**
Yield per rai (Tons/rai)	9		10	14	13	-	**12.0**
Cane price (Baht/ton)	475	-	480	600	519	-	**504.7**
Total revenue (Baht/rai)	4,275	-	4,800	8,400	6,747	-	**6,100**
Accounting profit (Baht/rai)	1,634	-	100	3,391	3,867	-	**2,802**
Economic profit (Baht/rai)	1,461	-	2	3,186	3,694	-	**2,652**

Source: Own survey (2004)

Appendix-Table 6.4: Total cost of sugarcane farms for the third ratoon

	North							Average
	N1	N2	N3	N4	N5	N6	N7	
Cash cost								
1.Variable cost (Baht/rai)								
1.1 Labour cost (Baht/rai)								
A. Soil Preparation	-	-	-	-	-	-	-	
B. Soil improvement	-	-	-	-	-	-	-	
C. Breed preparation	-	-	-	-	-	-	-	
D. Planting	-	-	-	-	-	-	-	
E. Fertilizing	210	-	27	60	-	130	-	
F. Chemical application	100	-	44	140	-	100	-	
G. Watering	16	-	-	83	-	-	-	
H. Weeding	130	-	-	83	-	-	-	
I. Harvesting	1,105	-	1,100	900	-	1,320	-	
1.2 Factor cost (Baht/rai)								
A. Breeding cost	-	-	-	-	-	-	-	
B. Fertilizer use	676	-	743	375	-	818	-	
C. Chemical use	170	-	84	151	-	280	-	
D. Watering cost	-	-	-	-	-	-	-	
E. Fuel and lubricant cost	45	-	148	57	-	87	-	
F. Management cost	18	-	14	10	-	13	-	
G.Maintenance Cost	5	-	79	50	-	-	-	
2. Fixed cost (Baht/rai)								
Land use cost	-	-	-	-	-	-	-	
Total cash costs (Baht/rai)	2,476	-	2,240	1,909	-	2,749	-	**2,343**
Total cash costs (Baht/ton)	310	-	224	212	-	250	-	**249**
Non cash cost								
Depreciation	28	-	127	59	-	27	-	
Opportunity cost of capital	160	-	115	111	-	138	-	
Total non cash costs (Baht/rai)	188	-	242	170	-	166	-	**191**
Total non cash costs (Baht/ton)	24	-	24	19	-	15	-	**20**
Total cost								
Total Cost/rai (Bath/rai)	2,664	-	2,482	2,078	-	2,914	-	**2,535**
Total Cost/ton (Bath/ton)	333	-	248	231	-	265	-	**269**
Yield per Rai	8	-	10	9	-	11	-	**9.5**
Cane price (Baht/ton)	520	-	460	467	-	450		**474.2**
Total revenue (Baht/rai)	4,160	-	4,599	4,202	-	4,950	-	**4,478**
Accounting profit (Baht/rai)	1,656	-	2,232	2,235	-	2,174	-	**2,074**
Economic profit (Baht/rai)	1,496	-	2,117	2,123	-	2,036	-	**1,943**

Source: Own survey (2004)

Appendix-Table 6.4: Total cost of sugarcane farms for the third ratoon (continue)

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

Source: Own survey (2004)

Appendix-Table 6.4: Total cost of sugarcane farms for the third ratoon (continue)

	Central					Average
	C8	C9	C10	C11	C12	
Cash cost						
1.Variable cost (Baht/rai)						
1.1 Labour cost (Baht/rai)						
A. Soil Preparation	-	-	-	-	-	
B. Soil improvement	-	-	-	-	-	
C. Breed preparation	-	-	-	-	-	
D. Planting	-	-	-	-	-	
E. Fertilizing	-	120	20	33	-	
F. Chemical application	-	180	53	200	-	
G. Watering	-	120	120	67	-	
H. Weeding	-	-	144	122	-	
I. Harvesting	-	1,200	1,470	1,200	-	
1.2 Factor cost (Baht/rai)						
A. Breeding cost	-	-	-	-	-	
B. Fertilizer use	-	1,120	1,000	600	-	
C. Chemical use	-	-	210	107	-	
D. Watering cost	-	-	-	-	-	
E. Fuel and lubricant cost	-	360	120	210	-	
F. Management cost	-	30	19	196	-	
G.Maintenance Cost	-	48	-	25	-	
2. Fixed cost (Baht/rai)						
Land use cost	-	1,000	1,500	1,300	-	
Total cash costs (Baht/rai)	-	4,179	4,656	4,060	-	**3,265**
Total cash costs (Baht/ton)	-	522	333	338	-	**307**
Non cash cost						
Depreciation	-	298	354	20	-	
Opportunity cost of capital	-	188	205	165	-	
Total non cash costs (Baht/rai)	-	486	559	185	-	**305**
Total non cash costs (Baht/ton)	-	61	40	15	-	**31**
Total cost						
Total Cost/rai (Bath/rai)	-	4,665	5,214	4,245	-	**3,570**
Total Cost/ton (Bath/ton)	-	583	348	354	-	**312**
Yield per Rai		8	14	12		**11.1**
Cane price (Baht/ton)		480	600	519	-	**512.6**
Total revenue (Baht/rai)	-	3,840	8,400	6,228		**5,771.2**
Accounting profit (Baht/rai)	-	-637	3,391	2,148	-	**2,355.7**
Economic profit (Baht/rai)	-	-825	3,186	1,983	-	**2,200.8**

Source: Own survey (2004)

Appendix-Table 6.5: Summary of the average total cost of sugarcane production classified by regions

Region		Total cost of sugarcane production			**Average**
		First ratoon	Second ratoon	Third ratoon	
North	(Euro/ha)	664	416	317	**466**
Northeast	(Euro/ha)	639	394	-	**516**
Central	(Euro/ha)	715	431	446	**531**
Average	**(Euro/ha)**	**673**	**413**	**382**	**489**

Source: Own survey (2004).

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

	Unit	Region	Ratoon			**Average**
			1	2	3	
Average yield	(Tons/ha)	North	67.4	65.6	59.4	**64.1**
		Northeast	65.1	58.8	-	**61.9**
		Central	80.5	74.8	69.6	**75.0**
		Average	**71.0**	**66.4**	**64.5**	
Average price	(Euro/ton)	North	9.5	9.8	9.5	**9.6**
		Northeast	10.1	10.2	-	**10.1**
		Central	10.0	10.1	10.3	**10.1**
		Average	**9.8**	**10.0**	**9.9**	

Source: Own survey (2004).

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

		Total revenue of sugarcane production			
Region	Unit	First ratoon	Second ratoon	Third ratoon	**Average**
North	(Euro/ha)	636	640	560	**612**
Northeast	(Euro/ha)	655	601	-	**628**
Central	(Euro/ha)	805	763	721	**763**
Average	**(Euro/ha)**	**699**	**668**	**427**	**667**

Source: Own survey (2004).

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

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

Source: Own survey (2004).

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

			Region			
	Unit	Ratoon	North	Northeast	Central	**Average**
Average break-even yield (TC/price)	(Tons/ha)	1st	67.1	64.5	72.2	**67.9**
	(Tons/ha)	2nd	41.4	39.2	42.9	**41.2**
	(Tons/ha)	3rd	31.7	0.0	44.6	**38.2**
	Average		**46.7**	**51.9**	**53.3**	
Average break-even price (TC/yield)	(Euro/ton)	1st	9.3	8.9	10.0	**9.4**
	(Euro/ton)	2nd	6.2	5.8	6.4	**6.1**
	(Euro/ton)	3rd	4.5	0.0	6.3	**5.4**
	Average		**6.6**	**7.4**	**7.6**	

Source: Own survey (2004).

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

			Region			
	Ratoon	Unit	North	Northeast	Central	**Average**
Average gross margin	1st	(Euro/ha)	33.5	103.9	151.0	**96.1**
	2nd	(Euro/ha)	295.9	269.3	412.9	**326.0**
	3rd	(Euro/ha)	266.9	-	387.8	**327.3**
	Average	**(Euro/ha)**	**198.8**	**186.6**	**317.2**	**234.2**

Source: Own survey (2004).

Appendix to chapter 7

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

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

Source: Own calculation and OCSB (2003)

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

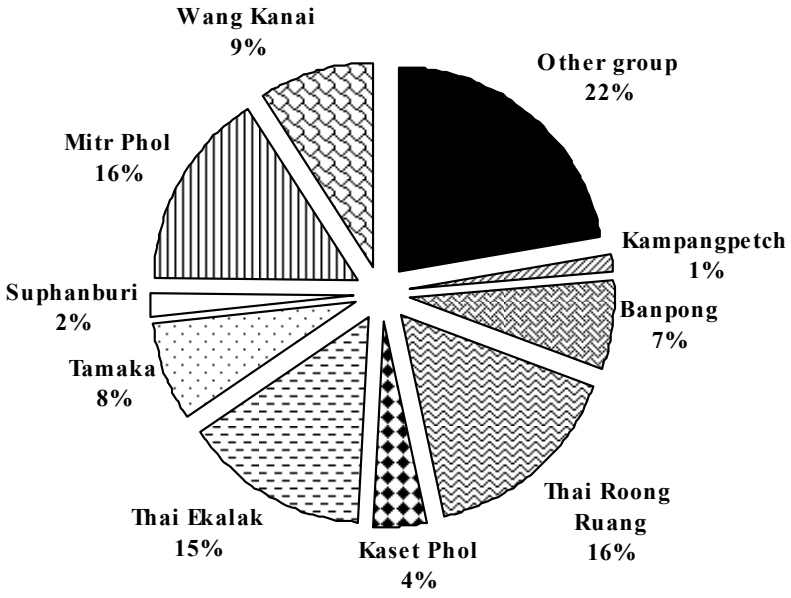
The analysis of the market share of each factory in the sample can not be done due to the limited available information. Therefore, the analysis of market share as an indicator for the competitiveness of the sugar industry can only be shown by the market share of sugar sale representative group and the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



Source: OCSB, 2004.

REFERENCE

ANZIBA. 2004. Modes for Enhancing Competitiveness: an Application of Transaction Cost in Australian Sugar Supply Chain. Conference Proceedings for the Dynamism and Challenges in Internationalization. Canberra, Australia.

Arsham, H. 2006. Break-Even Analysis and Forecasting. Maryland, USA: University of Baltimore, http://home.ubalt.edu/ntsbarsh/Business-stat/otherapplets/BreakEven.htm (accessed June, 2006).

ASA. 2005. Questions Most Frequently Asked About Sugar. USA: American Sugar Alliance, http://www.sugaralliance.org/desktopdefault.aspx?page_id=97 (accessed January, 2006).

Biz Dimension. 2006. Sugarcane Market Structure in Thailand. Bangkok, Thailand: Biz Dimension Co. Ltd, http://www.foodmarketexchange.com/datacenter/product/sugar/detail/dc_pi_sugar_04_04.htm#farmer (accessed January, 2006).

Biz. 2002. The Break-Even Point, Bristol, UK: University of Bristol, Institute for Learning and Research Technology, http://www.bized.ac.uk/virtual/vla/theories/break_even.htm (accessed June, 2006).

BOT. 2000. Summary of the production and sales of cassava in 2000. Thailand: Bank of Thailand (BOT), Monetary Policy Group, Agricultural and Services Team, Real Sector Department, www.bot.or.th/download/mpg/realsectors/paper_agri/cassava-00-e.pdf (accessed September, 2006).

CBP. 2006. North America Free Trade Agreement. USA: U.S. Customs and Border Protection, http://www.cbp.gov/nafta/docs/us/chap07.html (accessed June, 2006).

Chetthamrongchai, P., Auansakul, A., and D. Supawan. 2001. Assessing the Transportation Problems of the Sugar cane Industry in Thailand. *Transport and Communications Bulletin for Asia and the Pacific* No.70.

Department of Business Economic (DBE). 1998. Potential of Sugar Industry. Bangkok: Business Research Center, Faculty of Commerce and Accountancy, Thammasat University.

DSM. 2006. Sugar Product. India: Dhampur Sugar Mills Limited, http://www.dhampur.com/desc.asp?id=5&sid=14 (accessed January, 2006).

DTI. 2006. SA Intervention Compared to Australian and Thailand Measures. Republic of South Africa: Department of Trade and Industry, http://www.dti.gov.za/publications/SugarAct/7SAInterventionCompared.pdf (accessed April, 2006).

Ekasingh, B., et al. 2004. Maize in Thailand: Production Systems, Constraints and Research Piorities. Chiang Mai, Thailand: Chiangmai University, www.cimmyt.org/english/ docs/maize_producsys/thailand.pdf (accessed June, 2006).

F.O.Licht. 2004. The Thai Sugar Industry Enters an Era of Change. *International Sugar and Sweetener Report* 136 (18): June 15, 2004.

FAO. 1997. Sugar Industry of Thailand. USA: Food and Agriculture Organization of United Nation, Economics and Social Department, http://www.fao.org/documents/show_cdr.asp?url_file=/DOCREP/005/X0513E/x0513e24.htm (accessed January, 2005).

FAO. 2005. Farm Planning: Gross Margin. USA: Food and Agriculture Organization of United Nation, Economics and Social Department, www.fao.org/ag/AGS/subjects/en/farmMgmt/pdf/Mod2_3.pdf (accessed June, 2005).

FAO. 2006. Training Manual on Farm Planning and Management for Trainers of Extension Workers. USA: Food and Agriculture Organization of United Nation, Economics and Social Department, www.fao.org/ag/Ags/subjects/en/farmMgmt/pdf/HANDOUTI.pdf (accessed June, 2006).

FMA. 2006. Industrial Organization Theory and Competitiveness of International Banking and Financial Places: Application to the Industry of Investment funds. USA: The Financial Management Association International (FMA), http://www.fma.org/Siena/DSS/PHDProject.pdf (accessed May, 2006).

Foundation for Thailand Productivity Institute (FTPI). 2004. Project of the increased the Competitiveness of Sugarcane and Sugar industry. Bangkok: Foundation for Thailand Productivity Institute.

Frohberg, K. and M. Hartmann. 1997. Comparing Measures of Competitiveness. Discussion Paper 2. Halle(Saale), Germany: Institute of Agricultural Development in Central and Eastern Europe (IAMO).

Grimson, B. 2006. Post details: Watching An Isaan Rice Harvest. Brisbane, Australia.http://www.thai-blogs.com/index.php?blog=26&p=1131&more=1&c=1&tb=1&pb=1 (accessed June, 2006).

Gutierrez, P.H., and N.L. Dalsted. 2004. Break-Even Method of Investment Analysis. Colorado, USA: Colorado State University, http://www.ext.colostate.edu/pubs/farmmgt/03759.pdf (accessed June, 2006).

HA. 2005. Indicators for Triple Bottom Line Benchmarking of GRDC Farming Systems Projects. Sydney NSW, Australia: Hassall & Associates Pty Ltd, http://www.grdc.com.au/growers/res_summ/au1292/part3.htm (accessed November, 2005).

Harrison, R. W., and P.L. Kennedy. 1997. A Neoclasical Economic and Strategic Management Approach to Evaluating Global Agribusiness Competitiveness. *Competitiveness Review* 7(1): 14-25.

Harrison, R.W., and P.L. Kennedy. 1999. Trade, Technology, and Competitiveness: A Comparison of the European Union and the United States Sugar Sectors. USA: Department of Agricultural Economics and Agribusiness, Louisiana State University Agricultural Center, http://www.ifama.org/conferences/9/1999/1999%20Congress/Forum%20Papers_PROCEEDINGS/Kennedy_Lynn.PDF (accessed December, 2003).

Hofstrand, D. 2005. Farm Analysis Terms. Iowa, USA: Iowa State University, http://www.extension.iastate.edu/agdm/wholefarm/html/c1-05.html (accessed June, 2006).

IFCN. 2004. Methods: Typical Farms. Germany: International Farm Comparison Network (IFCN): the Institute of Farm Economics, part of the Federal Agricultural Research Center (FAL), http://www.ifcnnetwork.org (accessed March, 2004).

Isermeyer , F., Hemme, T., and J. Holzer. 2003. Analysis of international competitiveness of milk production in the framework of the IFCN. Czech Republic: Agricultural Economics of Czech, http://www.cazv.cz/2003/AE2_03/8-Isermeyer.pdf (accessed November, 2003).

Jintrawet, A., Laohasiriwong, S., and C. Lairuengroeng. 2000. Predicting the Effect of Planting Dates on Sugarcane Performance in Thailand. Proceedings of International CANEGRO Workshop. Mount Edgecombe, South Africa: 4-7 August 2000.

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,

http://www.agnr.umd.edu/MCE/Publications/Publication.cfm?ID=255 (accessed November, 2005).

Kennedy, P. L., Harrison, R.W., and M.A. Piedra. 1998. Analyzing Agribusiness Competitiveness: The Case of the United States Sugar Industry. *International food and Agribusiness Management Review* 1 (2): 245-257.

Kennedy, P. L., R.W. Harrison, N.G. Kalaitzandonakes, H.C. Peterson, and R.P. Rindfuss. 1997. Perspectives on evaluating competitiveness in agribusiness Industries. *Agribusiness* 13: 385-392.

Kongchindamunee, S. 2002. Export Competitiveness of Thai Sugar. Thesis. Chiangmai, Thailand: Chiangmai University.

Landau, R. 1992. *Technology, Capital Formation and U.S. Competitiveness*. In B.G. Hickman, ed., International Productivity and Competitiveness, New York, USA: Oxford University Press.

Lessley, B.V., Johnson, D.M., and J.C. Hanson. 1991. Cost and revenue considerations in farm management decision making. USA: Department of Agricultural Economics and resource economics, University of Maryland at College Park, www.agnr.umd.edu/MCE/Publications/PDFs/FS546.pdf (accessed November, 2005).

Makus, L. 2006. Farm and Agribusiness Management. Moscow, USA: University of Idaho , Department of Agricultural Economics and Rural Sociology, http://courses.ag.uidaho.edu/aers/agecon278/Fall05/Chap10.pdf#search=%22break%20even%20yield%22 (accessed June, 2006).

Manarangsan, S. and K. Kaewthep. 1987. Sugar Industry of Thailand. Bangkok: Institute of Asian Studies, Chulalongkorn University.

Martin, L., Westgeren, R., and E. van Durren. 1991. Agribusiness Competitiveness across National Boundaries. *The American Journal of Agricultural Economics* December: 1456-1464.

McCalla, A. F. 1994. *What did we learn from this conference ?*. Oxford, UK: Westview Press.

Montecillo, O.P., Jones, D., and D. Grey. 2006. Northern Victoria Irrigated Cropping Gross Margins 2005-06. Victoria, Australia: Department of Primary Industries, http://www.dpi.vic.gov.au/dpi/nrenfa.nsf/childdocs/-7A949C82752F004ECA256E76000DE0C0-

25932FEB7FA4CF28CA256FAB001075A8?open (accessed June, 2006).

Morgenroth, E. 2005. Competitiveness Concepts and Indicators: A Review of Dublin City. Dublin, Ireland: Dublin City Development Board, www.dublin.ie/getFile.asp?FC_ID=401&docID=1117 (accessed May, 2006).

Morton, J. 1987. Fruits of warm climates. Miami, USA: Purdue University, http://www.hort.purdue.edu/newcrop/morton/pineapple.html (accessed June, 2006).

Muhammad, Z. 2003. Open Dictionary. USA: The New Frontier Information Network, http://open-dictionary.com/Refine (accessed in June, 2006).

NaRanong, V. 2000. The Thai Sugar Industry: Crisis and Opportunities. *TDRI Quarterly Review* 15 (3): 8-16.

Netayarak, P. 1992. Future of Sugarcane and Sugar Industry of Thailand. Bangkok: Faculty of Economics, Thammasat University.

Netayarak, P., et al. 1994. The Future of Thai Sugarcane and Sugar Industry. Bangkok: Thailand Development Research Institution (TDRI).

Ngarmyarn, A. and W. Techawed. 1996. The Potential of Competitiveness of Sugar Industry. Bangkok: Faculty of Economics, Thammasat University.

Nielsen, J., Madsen, E. And K. Pedrsen. 1995. *International Economics: The Wealth of Open Nations.* Maidenhead, UK: McGraw-Hill Book Company Europe.

Nott, S., Betz, R. and G. Schwab.2006. How to use enterprise budget. Michigan, USA: Michigan State University, www.msu.edu/~schwab/enterprisebudgetj2000.ppt (accessed in June, 2006).

Office of Cane and Sugar Board (OCSB). 1982. *Sugar Industry in Thailand.* Bangkok, Thailand: Office of Cane and Sugar Board.

Office of Cane and Sugar Board (OCSB). 1990a. *The Introduction of Surveying Sugarcane Cost of Production: Production Year 1990/91*. Bangkok, Thailand: Office of Cane and Sugar Board.

Office of Cane and Sugar Board (OCSB). 1990b. The Thai Sugar Industry Structure. Prepared for the Seminar on the Thai Sugar Industry Structure for the Australian Sugar Delegation. Office of the Cane and Sugar Board, Thailand: 7 February 1990.

Office of Cane and Sugar Board (OCSB). 2003. *Sugar Industry in Thailand.* Bangkok, Thailand: Office of Cane and Sugar Board.

Petchworakul, P. 2001. Impacts of WTO Agricultural Liberalization on the Thai Sugar Industry. Department of Economics. Thesis. Bangkok, Thailand: Chulalongkorn University.

Porter, M. 1980. Competitive Strategy: Techniques for Analyzing Industries and Competitors. New York, USA: The Free Press.

Porter, M. 1990. *The Competitive Advantage of Nations*, New York, USA: The Free Press.

Porter, M. E. 1996. What Is Strategy?. *Harvard Business Review* November-December 1996: 61-78.

PRD. 2005. Rice Cultivation and Cycle: The Main Pillar of Thai Life and Culture. Bangkok, Thailand: The Government Public Relations Department, http://thailand.prd.go.th/the_inside_view.php?id=722 (accessed June, 2006).

Satitwityanan, S., et al. 2004. Project of Revenue Sharing System Study of Sugarcane and Sugar Industry. Bangkok: Faculty of Social Science, Kasetsart University.

Srijantr, T. 1998. Transformations du système agraire de Thung Look Nok (Plaine Centrale) et perspectives de l'agriculture thaïlandaise. Ph.D thesis, National Institute of Agronomy, Paris, 380 p.

Srijantr, T., Molle, F., and C. Chompadist. 1999. Profitability and Yield Gap of Sugar Cane Cultivation in the Mae Klong Region. Bangkok, Thailand: Kasetsart University, http://std.cpc.ku.ac.th/delta/deltacp/pubs/sugarcane.PDF (accessed April, 2004).

The World Bank. 1999. Global Commodity Markets: A Comprehensive Review and Price Forecast. January 1999. USA: Washington, D.C.: Development Prospects Group, The World Bank.

Thorne, F. 2004. Measuring the Competitiveness of Irish Agriculture (1996-2000). *Rural Economy Research Series* No. 9.

Van Duren, E., Martin, L., and R. Westgren. 1991. Assessing the Competitiveness of Canada's Agrifood Industry. *Canadian Journal of Agricultural Economics* 39: 727-738.

Wikipedia. 2006. High Fructose Corn Syrup. New York, USA: Answers Corporation,http://www.answers.com/main/ntquery;jsessionid=bdgaon5t72144?dsid=2222&dekey=High+fructose+corn+syrup&sbid=lc08a (accessed February, 2004).

Zimmermann, B. and J. Zeddies. 2001. International Competitiveness of Sugar Production. Stuttgart, Germany: Institute of Analysis, Planning and Organization of Agricultural Production, http://www.ifma.nl/files/papersandposters/PDF/Papers/Zimmermann_2.pdf (accessed September, 2003).