INDUSTRIAL MANAGEMENT SYSTEM COMPARATIVE ANALYSIS FOR SUGAR INDUSTRY IN THAILAND AND MYANMAR

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วัตถุประสงค์ของการทำวิทยานิพนธ์ในครั้งนี้เพื่อที่จะศึกษาและทำความเข้าใจการศึกษาเปรียบเทียบระบบการจัดการอุตสาหกรรมอ้อยและน้ำตาลระหว่างประเทศไทยและพม่าในแนวทางที่จะเสริมสร้างความมีประสิทธิภาพให้เกิดกับองค์กรอย่างสูงสุด โดยมุ่งเน้นในประเด็นที่เกี่ยวข้องกับความสำเร็จของอุตสาหกรรมน้ำตาล ความเข้าใจในพื้นฐานของอุตสาหกรรมน้ำตาลเป็นสิ่งสำคัญในการทำวิจัยในครั้งนี้ และได้มีการเก็บข้อมูลปฐมภูมิจากการสัมภาษณ์ผู้ทรงคุณวุฒิและทีมงานที่มีประสบการณ์ทางด้านอุตสาหกรรมน้ำตาล และได้เก็บข้อมูลทุติยภูมิมาจากหน่วยงานของรัฐบาลของทั้งสองประเทศรวมถึงข้อมูลจากบริษัทที่เกี่ยวข้อง

ผลการศึกษาในครั้งนี้ทำให้พบว่าอุสาหกรรมอ้อยและน้ำตาลของประเทศพม่าสามารถแข่งขันได้ทั้งตลาดภายในประเทศและระดับสากลเนื่องจากมีความได้เปรียบทางด้านทรัพยากรธรรมชาติแรงงาน ทั้งนี้ความสามารถในการแข่งขันจะเกิดขึ้นได้รัฐบาลพม่าควรให้ความสำคัญกับนโยบายที่ส่งเสริมอุตสาหกรรมอ้อยและน้ำตาล

ศูนย์ระดับภูมิภาคทางวิศวกรรมระบบการผลิต ลายมือชื่อนิสิต.....

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The objective of this project is to develop an understanding of the most functional and competitive means of analysis of business structure for sugar industry in Thailand and Myanmar in ways that will maximise benefits to the organisation. The paper focuses on the issues involve in the successful preparation of sugar industry.

The methods used in the project development include a preliminary understanding of sugar industry; their advantages and disadvantages; the collection of information and interviews of the qualified authorities; the experiment of the problem using depth interview; and the analysis of the results and the answer to the main project's questions on the system comparative analysis for sugar industry. It is found in this research that there are many main subjects in determining a competitive sugar industry in a context of competitive management system, which include process planning, price of raw material, transportation cost, improving line design, tax system, and space requirement for sugarcane farming. In addition, the example of ideal case for sugarcane factory and sugarcane farming that are suitable for the industry is presented in the paper. The expected significance of the project is the understanding of the most effective criteria of investing and improving a competitive sugar industry.

In the long run, Myanmar is still be competitive for investing in the sugar industry for domestic consumption and especially for export, because of land availability, cheap price, low wages for the laborers and there is enough water supply as the rainfall is 40-80 inches rain in sugarcane areas and moreover, the infrastructure will improve in the future.

Regional Center for Manufacturing Systems Engineering Student's Signature:……...
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Lastly, but no means least I would like to thank my father, my mother, and my brothers. They are the greatest people in my life who are always beside me and are my inspiration. Their love and support give me strength.

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CHAPTER 1

INTRODUCTION

XYZ ENGINEERING CO., LTD. AND ASSOCIATES which comprise of:-

1. XYZ ENGINEERING CO., LTD.
2. XYZ CONSULTANT CO., LTD.

was found in 1974. XYZ ENGINEERING CO., LTD. AND ASSOCIATES is a Thai based, internationally focused company, specializing in the field of sugar technology and related industry.

XYZ ENGINEERING CO., LTD. was established as an unite of the XYZ Group of companies with the express purpose of acquiring the workshop and developing into a modern engineering facility

XYZ CONSULTANT has considerable project experience, due to the accumulated experience of their engineers, technologists and technicians, since they were all previously stationed at sugar factories operating in Thailand. The project experience is developed further through a range of challenging projects both in Thailand and abroad.

XYZ CONSULTANT's experienced team of engineers, designers and project personnel provide a wide range of service including:

- Engineering, encompassing process, mechanical, civil, structural, electrical and instrument design and specification.
- Procurement of service, materials and plant including purchasing, expediting and inspection.
- Design and supply machineries.
- Logistics and shipment.
- Construction management and supervision.
- Project management and contract administration.
- Turn-key project.
- Feasibility and Front End engineering design packages.
- Conceptual Design for new and established process.

- Detailed design of complete process plant and plant modifications/rehabilitations.
- Strategies for modernization and upgrades of existing process plants.
- Factory performance audit.

Moreover, due to high efficiency and state-of-the-art technology, XYZ ENGINEERING CO., LTD.has become one of the top five leading manufacturers of machineries in Thailand that are able to meet international standard of production. XYZ ENGINEERING CO., LTD. also aims to expand its capacity to rival those in the same field such as sugar refining companies, paper mills, cement factories and industrial steel plants.

The executive board realized that the increasing growth of world population will increase the sugar consumption. Chairman of the board see the potential in neighborhood country, Myanmar, where can set up the sugar factory and operate at the lower cost than in Thailand. Furthermore, set up factory in Thailand require license from government and it is very difficult to get it because there is a lot of factory in Thailand.

Therefore, the international joint venture company was formed between **ABC SUGARCANE ENTERPRISE, a government enterprise organized under the Ministry of Agriculture and Irrigation and XYZ ENGINEERING CO., LTD. AND ASSOCIATES** June 1997. Whereas both parties are desirous of entering into a mutually beneficial joint venture to develop and operate the proposed new sugar mill to produce white sugar for export and sugar related products for domestic consumption as well. Both parties hereto are desirous of forming and floating a **Joint Venture Company in the form of a private limited liability company in the Union of Myanmar under the name of "ABC & XYZ CO., LTD."** This party operates under the Union of Myanmar Foreign Investment Law. The type of collaboration is illustrated below:-

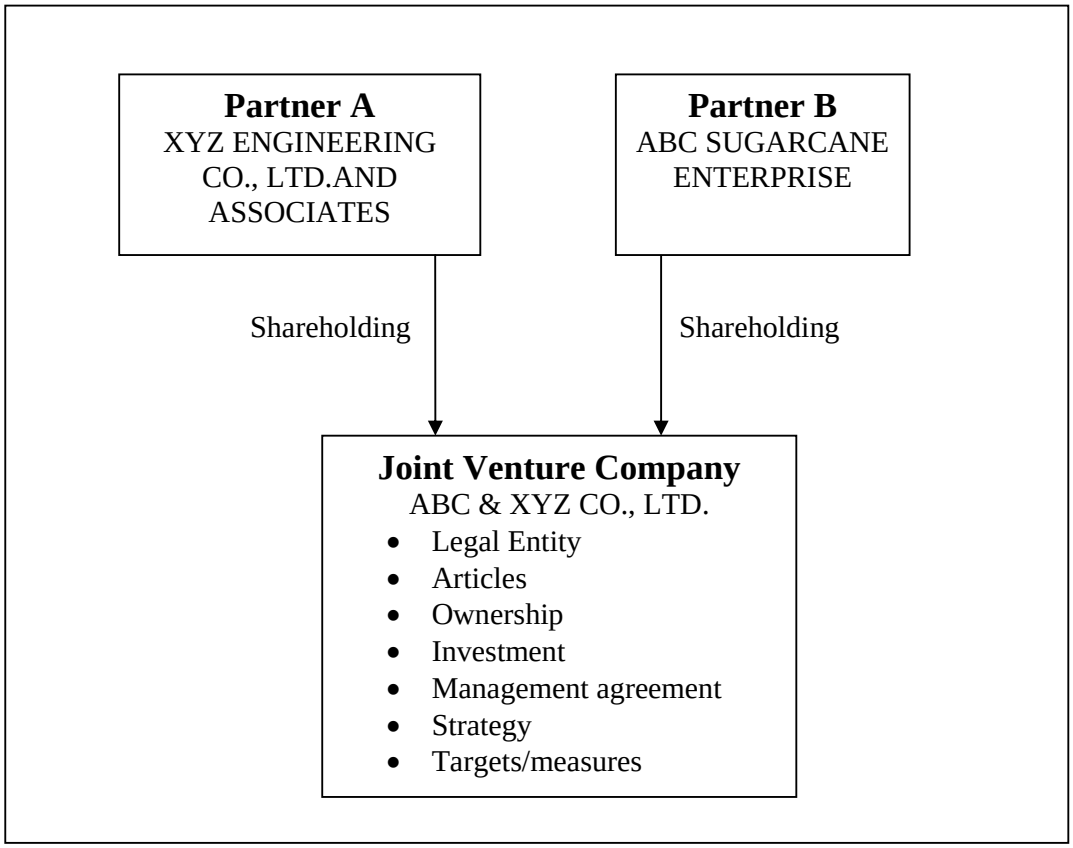

Figure 1-1: Type of Collaboration

(Source : WMG, International Joint Ventures Module Notes, 2006)

The objects for the establishment of the company are to carry on the business of producing sugar and sugar related products, marketing of the products overseas as well as locally.

The company managed by a board of directors comprising of five members, three to be nominated by XYZ CO., LTD. AND ASSOCIATES and two by ABC SUGARCANE ENTERPRISE and in which Chairman shall be from ABC SUGARCANE ENTERPRISE, and the Managing Director shall be from XYZ ENGINEERING CO., LTD. The remunerations of the Directors shall from time to time be determined by the company in general meeting.

1.1 PROBLEM STATEMENTS

The feasibility study was conducted in the first place, The Ministry of Agriculture & Irrigation of Myanmar promised to support agricultural plan to feed the sugarcane to the factory, and also the capacity of the factory is 300,000 MT of cane crushed per year will be reached in three years of operation, unfortunately, after the 4th year of operation the number of cane crushed per year was just under 140,000 MT as can be seen in the table 1.

Table 1-1: ABC & XYZ CO., LTD.: Performance on Sugar Recovery

Year	Cane Crushed (MT)	Production (MT)		Recovery %	
		Sugar	Molasses	Sugar	Molasses
1998-99	27674	1865	1928	6.74	6.97
1999-00	48621	3543	2767	7.29	5.69
2000-01	79532	7035	3617	8.85	4.55
2001-02	139635	13018	6195	9.32	4.44
2002-03	90910	8475	4104	9.32	4.51
2003-04	52288	4300	2436	8.22	4.66
2004-05	65963	5938	2814	9.00	4.27
2005-06	80616	7720	3485	9.58	4.32
2006-07	108262	10660	4820	9.85	4.45
2007-07	119000	11353	5694	9.54	4.78
2008-09	124451	124451	-	-	-

The reasons behind this, firstly, The Ministry of Agriculture & Irrigation did not encourage farmer around the factory to cultivate sugarcane, the land use policy did not allows farmer to choose with there own choice, paddy is the priority policy crop. Moreover, the government did not support the price of sugarcane, hence, the price of sugarcane was too low. In addition, the yield of sugarcane per Hectare is too low, for instance, in 1999-00 and 2006-7 yield per Hectare of sugarcane was 43.47 and 56.57

MT (Source: Ministry of Agriculture and Irrigation,. Settlement and Land Records Department).

In conclusion, the business structure for sugar industry using in Myanmar is not efficient, so this thesis will develop comparative analysis of business structure for sugar industry in Thailand and Myanmar.

1.2 AIMS AND OBJECTIVES

Develop comparative analysis of business structure for sugar industry in Thailand and Myanmar in ways that will maximise benefits to the organisation.

1.3 RESEARCH METHODOLOGY

The steps undertaken on the research are chronologically listed below:

- Insight to the broad view of the sugar refinery process, operation and management and sugar business in Thailand and Myanmar.

- Understand the stages involved in sugar business, such as, contract farming, operation & management and etc.

- Data analysis by using qualitative research.
  The method using in qualitative research process is “Depth Interview”, the result of this process will be analysed in the followed step (the method is subjected to change depending on the validity and reliability of information)

- Review of collected data and combined the results and information from all sources of research methodologies and formulate conclusions that provide the answers to the main research questions.

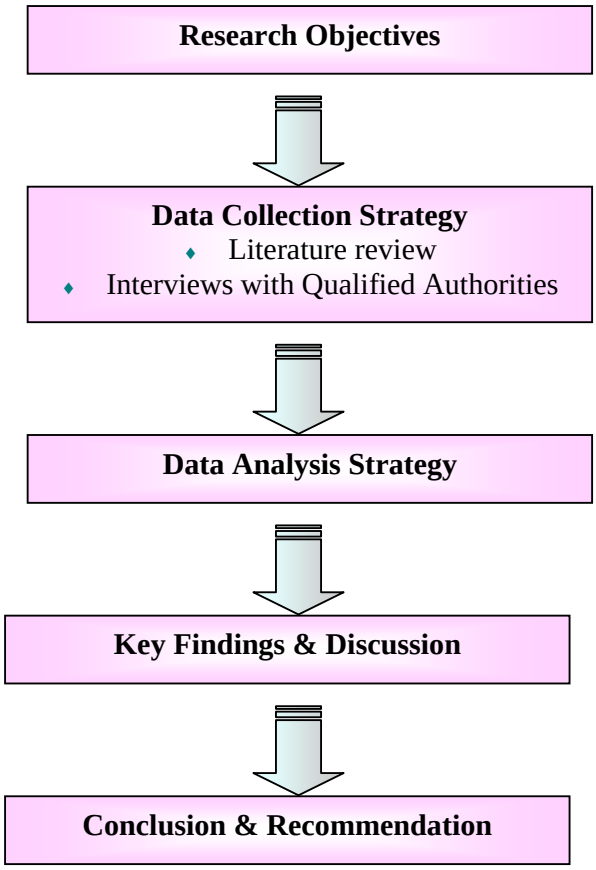

Figure 1-2: A Flowchart of Research Methodology

CHAPTER 2

LITERATURE REVIEW

This chapter introduces the brief profile of sugar industry and particularly sugar refining process. It also provides information on two main raw materials for sugar production. These enable readers to have a better understanding of the background of this study.

2.1 BRIEF PROFILE OF SUGAR INDUSTRY & SUGAR PROCESSING

2.1.1 BRIEF PROFILE OF SUGAR INDUSTRY

The sugar industry is the most advanced processing industry in the agriculture sector compared to others. The two most important raw materials used for sugar extraction are sugarcane and sugarbeet. Sugarcane is a tropical grass belonging to the same family (Gramineae) as sorghum, johnson grass, and corn (maize). Average sugar content in sugarcane is approximately 12 percent sucrose whilst in sugarbeet, sugar content is as high as 18% percent. The sugarcane is suitable to be grown in tropical and subtropical regions while the sugarbeet is likely to be cropped in cold regions. In addition, sugar is produced in 121 countries where the global production now exceeds 130 million tons a year. Moreover, approximately 70% of sugar production produced by sugarcane and the remaining 30% is produced from sugarbeet.

Sugarcane

Sugarcane is a genus of tropical grass which requires strong sunlight and abundant water for satisfactory growth. The Latin names of the species include *Saccharum officinarum*, *S. spontaneum*, *S. barberi* and *S. sinense* (Hugot and Jenkins, 1986). The cane itself looks rather like bamboo cane and it is here that the sucrose is stored. Moreover, in the right climate (tropical areas) the cane will grow in 12 months before cultivation. After cutting, the ratoon will re-grow in another 12 months before it can be harvested again.

Figure 2-1 :Sugarcane

In addition, typical sugar content for mature cane would be 10% by weight, however, the figure depends on the variety and varies of locations and moisture. In other words, the yield of cane varies depending on different kind of factors, i.e. landscapes, atmosphere. Moreover, the average of sugar production is 100 tons of cane per hectare or 10 tons of sugar per hectare.

Figure 2-2 Sugarcane field

Sugarbeet

Sugarbeet is a temperate climate biennial root crop. It produces sugar during the first year of its growth age. Then, over the winter, it flowers and seeds in the second year. The seeds are sown in spring and harvested in the first autumn or early winter. As for sugarcane, there are many cultivars sugarbeet available for the farmer. The beet stores the sucrose in the bulbous root which bears a strong resemblance to a fat parsnip (Hugot, 1986).

A typical sugar content for mature beets is 17% by weight but the value depends on the variety as well as amount of rain and quality of soil. Normally sugarbeet provides more sucrose than sugarcane compared by weight. However, the yields of beet per hectare are a bit lower than sugarcanes by producing only about 7 tons per hectare. (www.sucrose.com).

Figure 2-3 :Sugarbeet

Figure 2-4 : An Interactive World Map of Sugar Production**.**

By comparison between a beet sugar factory and sugarcane factory, the farmers have an advantage in that raw materials are more uniform and almost perfectly clean when it reaches the beet slicer or cutter. Alternatively sugarcane is usually mixed with a great deal of foreign matter. The quality of the sugarcane changes frequently for various reason, for example, the differences between plant varieties of cane or ratoon, the variations in maturity, and cropped times of the sugarcane, which is a highly perishable crop, the damaging during lodging, and disease infection, etc. These different factors will cause a variation in juice quality during processing leading to the fluctuation in terms of sugar production.

History of Sugar Plantation

According to Jartickawanich (1979), Columbus introduced sugarcane from the Canary Island to Santo Domingo, now the Dominican Republic. In the early sixteenth century, sugarcane culture spread to Mexico, Brazil and Peru and later to the West Indian Islands. Louisiana in the USA began sugarcane culture in 1751. Independent of this western movement was the introduction of sugarcane culture to Mauritius, Reunion, and Hawaii in the eighteen century and to Australia, Fiji and South Africa around 1800.

The discovery of beet sugar was the product of recent scientific effort. In 1749, the German Chemist, Marggrof published results of experiments showing that sugar could be obtained from white beet. By 1880, beet sugar production equalled that of sugarcane. Sugar beets are inexpensive, and represent an annual crop adapted to a wide range of soils and climate. Because of these and other factors, sugarbeet farmers can increase or decrease production rapidly to take advantage of price fluctuations.

The earliest sugar mills were initially operated by manpower, then by animal or water power. Screw and levered presses were widely used for juice extraction until superseded by the roller mill. Animals, water wheels and windmills developed in the East were widely used to power mills. Steam drives were first used in sugarcane milling in Jamaica in 1768. Evaporation of juices in thin clay pans, then in metal pans, singly, or in trains, was practiced for centuries. The evolution of steam evaporators, vacuum pans, multiple-effect evaporators, and so on, led to the implementation of higher efficiency equipment and machinery in sugar factories today.

According to the current methods centrifugal sugar manufacturing, which require sugarcane as primary raw material, sugar mills are erected to mill sugarcane for producing raw sugar and/or plantation white sugar. Sugar mills integrated with a refinery can produce refined sugar by using raw sugar as a secondary raw material. In some regions where cane or beet supply is not enough, a sugar refinery is a more feasible choice. A raw sugar is delivered into the factory to be purified, decoloured, and centrifuged to give a better quality sugar. The

followings contain some details concerning sugar processing both in a sugar cane factory and sugar refinery. Generally, those centrifugal sugars shall be more or less close to the following specifications:

Table 2-1 :Sugar Specification

	Plantation		
	Raw Sugar (Japan)	White Sugar (Foremost Friesland Ltd.)	Refined Sugar (EEC Grade 2)
Polarization, °Pol (min.)	97.0	99.5	99.7
Moisture, % (max.)	0.6	0.1	0.06
Ash, % (max.)	0.5	0.1	0.02
Color, I.U. (max.) @ 420 nm.	3,500	100	45
Reducing Sugar, % (max.)	0.6	0.05	0.04
Coefficient of Variation, (max.)	25	20	20
Rendement, % (min.)	94	-	-

2.1.2 MAIN STEPS IN CANE MILLING & RAW SUGAR PROCESS

1. Sugarcane is transported to the sugar mill where it is first weighted and then unloaded by gantry-cranes or hydraulic tippers onto a cane carrier. The carrier then conveys the cane to revolving cane knives and cane shredder so as to cut and shred the cane respectively into fibrous material.
2. Pairs of rollers feed the shredded cane into series of crushing mills. Each crushing mill consists of three large rollers arranged in triangular formation so that the shredded cane is crushed twice at each mill. Juice crushed from the milled cane is

pumped away for processing into raw sugar. The remaining fibrous material (bagasse) is used as a fuel in the boiler furnace.

3. Juice from the crushing mills contains impurities which are removed by adding milk of lime and boiling the limed juice. The lime neutralizes acids and precipitates impurities which settle out in clarifier. Clear juice is run off from the top of each clarifier. Muddy juice extracted from the bottom of the clarifiers is mixed with fine bagasse which is used as filter aid, then filtered, using rotary vacuum filters. The mud and bagasse extracted by the filter are used as fertilizer.

4. Juice from the clarifiers is concentrated to be syrup by evaporating most of water from it under vacuum in a series of connected vessels called evaporators.

5. The syrup (about 70% sugar) is boiled again in vacuum pans and more water evaporated. When the syrup is sufficiently concentrated, raw sugar crystals form and grow up. When the crystal reaches a predetermined size, the mixture of syrup and crystals (massecuite) is released through the bottoms of the pans.

6. Molasses (mother liquor) is separated from the raw sugar crystal in centrifugals, perforated baskets which spin in a casing at given high speed. The dark molasses mass surrounding the crystals is thrown off through the perforations. The spun-off molasses is boiled again and more raw sugar crystals are recovered. This procedure is repeated until the amount of sugar which can be obtained is too small to make further extraction economic. The final molasses is used mainly as a stock food and in distilleries to produce industrial alcohol, gasohol (fuel alcohol), rum and carbon dioxide including dry-ice. Moreover, the final molasses can be used widely in fermentation industry to produce Mono Sodium Glutamate (food seasoning), citric acid, acetic acid, etc.

7. The raw sugar from the centrifugals is dried by being tumbled through a stream of air in a rotating drum. It is then transferred to storage in buffer bins for supplying

the refinery station, and storage in silo waiting for export or short-term storage for off-season production of refined sugar.

2.1.3 MAIN STEPS IN REFINED SUGAR PROCESSING

1. Raw sugar (not in the case of high polarisation and very high-polarisation (VHP) raw sugar) is mingled with a hot concentrated syrup to soften the outer coating on the crystals. The crystals and green syrup are then separated by spinning in an affination centrifugal. The crystals are washed with hot water and discharged from the centrifugal then melted in hot water or sweet water.
2. The melted sugar liquor is then “carbonated” lime and carbon dioxide from the purification flue gas station are added to form a precipitate of chalk (calcium carbonate) which entraps many of the remaining impurities.
3. The carbonation precipitate is removed by pressure filtering the carbonated liquor through filter cloth. The resulting filtered liquor (brown liquor) is clear but straw coloured.
4. The filtered liquor passes through decolorising columns (decolorising ion exchange resins) or decolorising agent (activated carbon, granular carbon, bone-char, etc.), where the colouring matter is adsorbed. The final decolorised liquor then passes through check filters so as to remove any contaminated insoluble matters. The fine liquor is now clear and almost water white.
5. The fine liquor is concentrated by double or triple effect evaporators and then boiled in a vacuum pan and seeded with fine sugar crystals, which grow up to the required size by further boiling and by adding more liquor.
6. When the crystals reach the required size, the mixture of crystals and mother liquor, called massecuite, is discharged from the pan. The crystals are separated from the syrup (refinery term means ‘molasses’ but correctly called ‘syrup’ or ‘run-off’ or

'jet') in a second set of centrifugals. The separated syrup is re-boiled and more sugar is extracted from it.

7. Wet refined sugar crystals from centrifugals are dried and cooled by a pre-dryer, a vibrating screen to separated sugar lumps. The resulting screened sugar then enters the fluidised-bed type dryer/cooler to further reduce its moisture and cool down to ambient temperature. Dried and cooled refined sugar is then discharged to a feed bin of an automatic bagging machine that weights a predetermined batch of sugar and discharges the sugar to bags. The bagged sugar falls onto a belt conveyor passing through bag closing machine. After bag closing the bagged sugar is directed to another belt conveyor going to the sugar warehouse. The flowchart of sugar refinery processes is shown in next page.

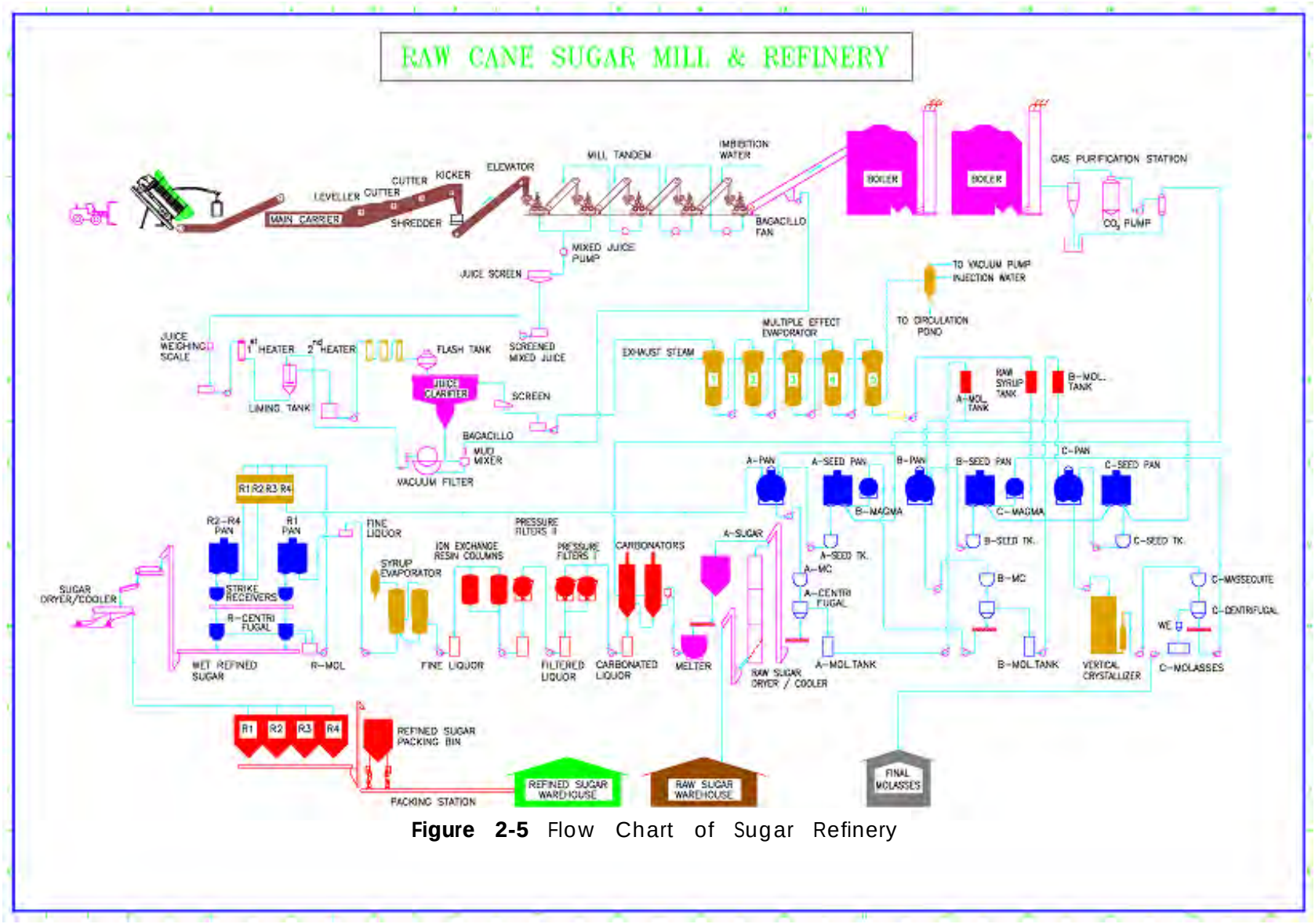

Figure 2-5 Flow Chart of Sugar Refinery

2.2 TYPES OF MANUFACTURING PROCESS

This part of the chapter aims to demonstrate different types of manufacturing process in sugar refinery industry. Firstly, the brief manufacturing process is explained. Then, choices in each important stage are presented and compared to find the most suitable circumstance in which they shall be installed.

The quality of refined or white sugar tends to be judged by most consumers, whether industrial or domestic, first and foremost on its whiteness, or absence of colour. Insoluble impurities in the sugar are also very undesirable; even a small proportion tends to give the crystals a dull appearance.

In the refinery, the removal of colour and turbidity takes place in a number of successive steps in the process. The overall reduction of colour between the raw cane sugar and the refined crystalline product is about 99%; typically from about 3,000 to 30 colour units.

The first purification process in a refinery is the removal of the surface layer of molasses from the relatively pure sucrose crystal. This surface layer contains a high proportion of the total impurities in the raw sugar and the washing, or affination, process typically in the original raw sugar. The washed crystals are dissolved in water to yield syrup, often referred to as melt liquor, which goes forward for further purification.

The final purification process in the refinery is the separation of the sucrose in a very pure form by crystallization. Although the crystallization process is very efficient, the crystal only containing about 10% of the purities present in the mother liquor, the melt liquor must be both clarified and decolourised to produce the syrup from which good quality refined sugar can be crystallized (Honig, 1959).

The sole aim of sugar factories in many cane sugar producing countries in the past was to produce a brown raw sugar for export to off-shore refineries in developed countries for refining. In such cases simple juice clarification using lime was the only treatment needed before crystallisation. However, in the recent years, it has been necessary for sugar factories to produce higher quality raw sugar for export and good quality refined or semi-refined white sugar for direct consumption. Consequently, clarification and decolourisation process used in sugar factories have had to be improved

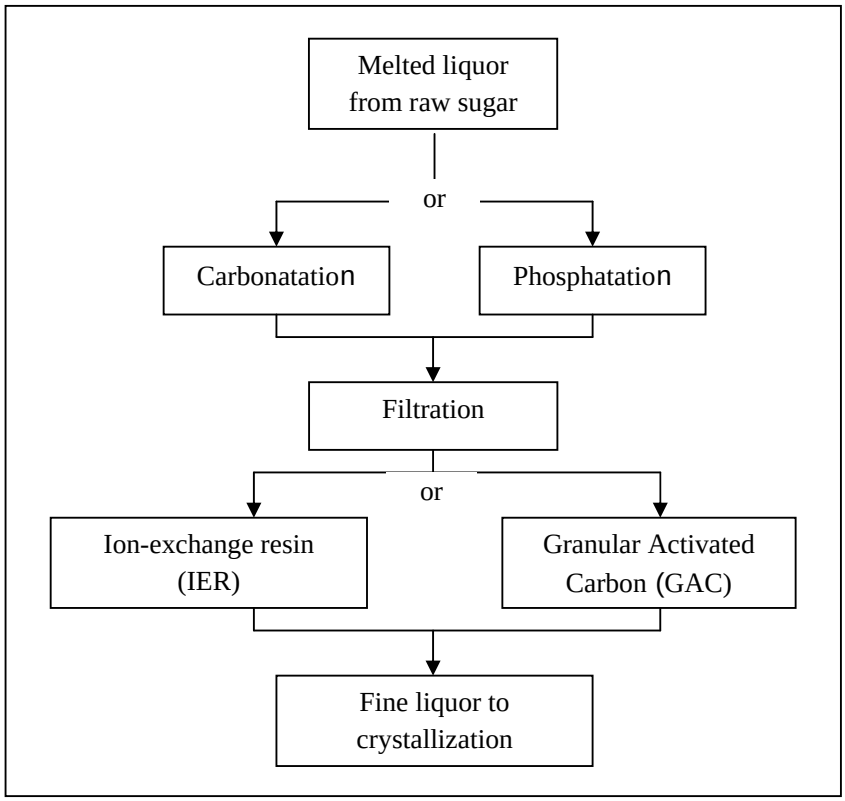

Figure 2-5 : Sugar refinery melt clarification processes

In the process of clarification of the melted sugar, there are two main stages which are purification and decolourisation. Factories normally adopt for carbonatations process or phosphatation process for purification of sugar depending on several criteria.

Similarly, decolourisation process is usually a choice of Ion-Exchange Resin or Granular Activated Carbon. These processes are explained in detail in the following parts of this chapter.

2.2.1 PHOSPHATATION

Figure 2-6 :Raw sugar in warehouse

Clarification of melter liquor by phophatation was originated in refineries in the United States. Basically, the process consists of precipitating insoluble calcium phosphate of variable composition in hot melt liquor by first adding calcium hydroxide, either as slurry with water or dissolved in sugar syrup as lime sucrate, to give a final pH of 7.2 - 7.4 (Honig, 1953).

Originally, a batch phosphatation process was used in which the phosphates were precipitated in the liquor as outlined above, the treat liquor then heated to a temperature of 85-90^{o} C and allowed to stand until the insoluble phosphates formed a flog. Diatomaceous earth filter aid was mixed in as a body aid and all the liquor filtered.

This batch process was superseded by a simple continuous flotation process, which achieved a similar degree of decolourisation and purification, but avoided the difficult removal of the floc by filtering all the liquor and therefore required less filtering equipment. In the continuous process the melter liquor is treated with phosphoric acid or acid phosphates at a higher level than in the batch process, namely, 200-500 parts per million on brix solids as P_2O_5, depending on the colour and general quality of the melter liquor being processed. Lime slurry or lime sucrate is added to give a pH of 7.1 - 7.4. The treated liquor is aerated and then flows to a continuous flotation clarifier where, during a retention period of 20 – 50 minutes, the liquor is slowly reheated, and the insoluble phosphates are carried to the top of the liquor by the expanding air. The scum so formed contains inorganic impurities, suspended solids and colour absorbed and trapped in the calcium phosphate floc. It is gently raked from the surface and the clarified liquor is removed from the bottom of the clarifier (Honig, 1953).

Figure 2-7 :Fine liquor concentration

The clarified liquor from such flotation clarifiers contains traces of insoluble suspended matter and this is normally removed by polish filtration to protect the

following decolourising medium such as bone char, granular carbon or ion-exchange resin.

The volume of scum is generally between 5% and10% of the volume of liquor treated, and the sugar liquor in the voids between the floc particles is quoted considerable, particularly if the scum layer is not well compressed. The scum is de-sweetened by diluting with water to about 20% solids content, adding filter aid and filtering using a pre-coated filter.

2.2.2 CARBONATION

Clarification of melter liquor by carbonatation has been used in Britain since cane sugar refining was established over 100 years ago, and is also the normal clarification process used in many other refineries in Europe, Australia and South Africa. It has recently been adopted by some refiners in North America.

The process consists of precipitating calcium carbonate in the melter liquor by adding a slurry of calcium hydroxide and then bubbling carbon dioxide through it under controlled conditions of alkalinity and temperature. The object of carbonatation is to precipitate the insoluble calcium salts of certain ionic impurities, e.g. sulphates, and to remove as much as possible of the insoluble and semi-colloidal impurities, such as starch, gums, protein and some coloured substances. These impurities are both absorbed by, and enmeshed in, the conglomerated particles of the calcium carbonate precipitated by the reaction of the carbon dioxide and calcium hydroxide. It has been shown experimentally that comparatively little of the lime is directly involved in the purification process as such, which is not particularly sensitive to temperature, pH, and residence time. Most of the lime needs to be precipitated with sufficient carbonatation to act as a filter aid which are dependent upon the reaction conditions.

If the impurities are to be removed efficiently the reaction conditions must ensure that the physical nature of the precipitate formed is such that it can be easily removed by filtration.

Figure 2-8 :CO2 gas purification and compressor

Figure 2-9 :Carbonated liquor filtration

The quantity of lime needed and added as a slurry containing 12 – 15% w/w CaO, varies with the characteristics of the particular melter liquor being processed, but for normal conditions the optimum dose rate is generally in the range of 0.6 – 1.0% CaO on melter liquor solids (Honig, 1953).

The carbon dioxide is obtained from washed boiler flue gas, typically containing 8.5 – 10% carbon dioxide, compressed in rotary compressors and pumped to the saturation tanks. The introduction of the CO_2 is usually a two-stage operation with the major part of the gassing taking place in the first saturator at a temperature of 80 – 85^{o} C. The amount of lime added and the pH of the fully carbonated liquor must be carefully controlled if the main requirements of good filterability and colour removal, together with a useful drop in ash content, are to be met.

Separation of the clarified liquor from the calcium carbonate precipitate is by filtration on vertical leaf filters, preferably of the rotating leaf type. In recent years it has been found more economical to use synthetic filter cloth, which can be acid treated and reused, rather than cotton cloths which can only be used for a limited period. Because of the quantity and nature of the precipitated calcium carbonate, no external filter aid is required for precoating the filter, or for body aid during the filtration cycle.

At the end of the filter cycle, the residual cake is sluiced from the plates with hot water and run from the filter body as a sludge. These sludges are re-filtered, usually on plate and flame pressed, and residual sugar washed from the cake before disposal.

2.2.3 GRANULAR ACTIVATED CARBON (GAC)

Activated carbons are prepared from a variety of raw materials of vegetable origin, such as wood and paper mill products, or of mineral origin, such as coal. They are activated by various methods, including thermally and chemically with acids, various salts, etc. The method of activation determines the effectiveness of the carbon as a decolourising of sugar syrups. Different types of carbon also have varying degrees of affinity for the different colour constituents in sugar syrup.

The granular activated carbons, normally used in the sugar industry, are prepared from coal. In common with all activated carbons, they have a high carbon content (about 90%), but the residual inorganic constituents do not give this material any of the buffering or de-ashing properties useful in bone char. Consequently, a small addition of magnetite is made to the granular carbon during service to prevent a drop in pH of the treated liquor. Granular carbon decolourisation is sometimes followed by ion-exchange de-ashing.

The granular carbon decolourisation system is operated in the same way as the bone char system, but the service time is very much longer and the regeneration rate is only about 0.5 – 0.8% on sugar solids treated. Consequently, the physical size of both the operating and the regeneration plant is much less than for a bone char plant of a similar capacity and the lower capital and operating costs can make this decolourising system economically more attractive.

There is a decolourisation system, patented under the name of CANESORB, in which a granular carbon is added to, and acts in conjunction with, bone char. The absorbent is essentially a mixture of granular carbon and bone char in a ratio of about 1 to 2 by volume. Its properties are said to be such as to give it the decolourising characteristics

of very good quality granular carbon. The mixture is regenerated at bone char regeneration temperatures of 500 – 600^{o} C, but in practice a reduced burn rate of about 70% of that using bone char alone is claimed. The most likely application for this material would appear to be as a means of increasing the effective capacity of an existing bone char installation by blending in a proportion of the more highly absorbing CANESORB. However, the success of this application depends on the practicability maintaining the condition of mixed absorbents when regenerated under compromise conditions.

2.2.4 ION-EXCHANGE RESINS

The use of synthetic quaternary resins for the decolourisation of sugar syrups dates from the 1950's. However, the micro-porous, highly cross-linked polymeric matrix structure of the cellular synthetic resins available at that time led to rapid fouling if the colour of the liquor being treated was more than about 150 I.U. These resins can be used successfully for treating very light colour liquors for special purposes, but great care must be taken to ensure that the maximum allowable colour level is not exceeded.

Figure 2-10 :Ion exchange resin decolorisation

Developments in resin manufacture in the following decade resulted in the production of exchange resins based on a stryrene-divinylbenzene a copolymer containing macro reticular pores. These resins are ideal for polishing duties because of their selectively and ultimate capacity for colour, including the larger colour molecules, although less easily fouled than the gel resins, they can be irreversibly fouled if regularly exposed to colour levels above 400 – 500 I.U (Mondia, 1992).

A third, and even more significant, advance was made during the 1970's with the development of acrylic based quaternary resins. This type of resin has a high decolourisation efficiency coupled with the advantage that it can cope with high colour levels in the syrup being treated and the colour absorbed can be removed quite readily from the resin by normal regeneration with a 10% solution of common salt. Consequently, the combination of an acrylic resin in the primary position to remove the dark colours followed by a styrene based resin for polishing to remove the final colour has proved ideal. Employing the acrylic resin in this way makes it possible to use an all ion-exchange decolourisation system in cane sugar refineries without the use of bone char or activated carbon.

As is the case for most natural plant extracts, practically all of the coloured bodies and colour precursors found in sugar juices and syrups are ionic in nature, being negatively charged in neutral or basic media. Furthermore, strong base anion exchange resins are employed for the decolourisation of natural products in many applications apart from sugar refining. To allow the strong base resin to be operated at elevated temperatures, as is necessary when treating sugar syrup, the exchanger is used in the chloride form. Some of the coloured fraction is removed in exchange for chloride ions but a significant portion of the colour is removed without being exchanged for another anionic species. Such adsorptive processes involve primarily

the aromatic matrix of the anion exchange resin rather than the ionic functionality. In other words, colour is bound to the anion exchanger by a combination of electrostatic and hydrophobic bonding. Many of the colour constituents in sugar syrups have some aromatic character and as such would be held by bonding with the matrix of the acrylic resins. The selectivity of the acrylic backbone is sufficiently high to reduce the colour by 60 -80% in practical treatment, but, because of the lessened selectivity, the colour absorbed is efficiently removed with 10% aqueous brine (Mondia, 1992).

The emergence of resins as new decolourisation media has given a more compact, less labour intensive process which uses less fuel and is lower in capital costs than a comparable decolourisation operation using carbonaceous absorbing requiring thermal regeneration.

The design of resin cells, their performance with various types of resins and under different operating conditions and the efficiency of various regeneration methods have been the subject of many publications in the last decade.

2.2.5 REFINED SUGAR CRYSTALLISATION

Refined sugar crystallization starts with R1 massecuites boiling. Concentrated fine liquor from the evaporator is concentrated further in the vacuum pan until it reaches super saturation point. A certain quantity of previously prepared sugar slurry is injected to from sugar crystals. The resulting sugar crystals are developed by boiling up with fine liquor until it reached full strike volume. The massecuites is concentrated further to about 89 - 90 º Bx. before dropping to the strike receiver.

Figure 2-11 :Vacuum pan

The R-1 molasses separated from the sugar crystals is pumped to the storage tank in the pan floor and used for R-2 massecuites boiling. The boiling procedure for this type of massecuite is the same as in R-1 massecuite boiling except that it uses R-1 molasses instead of concentrated fine liquor. Purging procedure is also the same. The molasses produced during the 2nd purging is also returned to the pan floor and used for R-3 massecuite boiling. Boiling and purging procedures are also the same as in R-1 boiling. Molasses produced during the 3rd purging is also sent to pan floor station and boiled as R-4 massecuite to recover as much sugar as possible.

Boiling and purging procedures are also the same as the 1st grade massecuite. R-4 molasses produced during the 4th purging is pumped to the affination section. It is mixed with affination run-off and used as mingling syrup for the incoming raw sugar to form magma. Excess mingling syrup is sent to the recovery station. Refined sugar crystallization employs the straight boiling system.

2.2.6 REFINED SUGAR MASSECUITE PURGING

The refined massecuites from the strike receiver is discharged continuously to the massecuites distributor for feeding to batch type centrifugals. During purging, hot water is sprayed on the sugar after separating the mother liquor to remove the residual film of molasses adhering on the surface of the crystals. During spinning, most of the water content of sugar is removed. The resulting sugar which contains about 1% moisture is discharged to a conveyor and fed to bucket elevator. From bucket elevator, sugar is discharged to wet sugar bin for feeding to sugar dryer.

This procedure applies to all types of massecuites (R-1, R-2, R-3, R-4). Molasses produced from purging R-1 massecuite is pumped to a storage tank in the pan floor and used for R-2 massecuite boiling. R-3 molasses is also sent to pan floor and used for R-3 massecuite boiling. Molasses from R-3 massecuite is likewise used for R-4 massecuite boiling. R-4 molasses is sent directly to recovery station and used for boiling A-sugar to recover as much sugar as possible.

Figure 2-12 :Centrifugal

2.2.7 REFINED SUGAR DRYING & COOLING

Refined sugar from centrifugal contains about 1% moisture at temperature of about 65-70 ºC. It is discharged to a grasshopper conveyor and then fed to bucket elevator. From the elevator, the sugar is discharged to a wet sugar buffer bin. This bin is equipped with rotary type feeder that discharges the wet sugar at uniform rate to the pre-dryer.

Figure 2-13 :Pre-dryer machine, and dryer & cooler

The sugar inside the pre-dryer comes in contact with hot air and reduce its moisture content. The partially dried sugar is then discharged to a vibrating screen to separate the sugar lumps. The resulting screened sugar enters the fluidized bed type dryer/cooler to further reduce its moisture and cool down to ambient temperature. The dried and cooled refined sugar is discharged into distributing conveyors for storage into the sugar bins prior to bagging. Separate bins are provided for each grade of sugar. Sugar lumps separated by vibrating screen is sprayed with hot water and flows to lump sugar melter. The resulting sweet water is used as spray water to the cyclones to collect and melt the sugar dust. Excess sweet water overflows to the main sweet water storage tank.

2.2.8 BLENDING & PACKING

Different grades of refined sugar are stored in individual storage bins. From the sugar bins two or more grades of refined sugar are discharged proportionally and simultaneously to a blending belt conveyor feeding to the bucket elevator. The sugar is elevated and discharged to another vibrating screen to separate sugar lumps formed during storage. The screened blended sugar falls to buffer bin feeding to the automatic sugar weighing and bagging machine. The weight of sugar discharge by the weighing machine is set at 50 kg ± 0.01 kg.

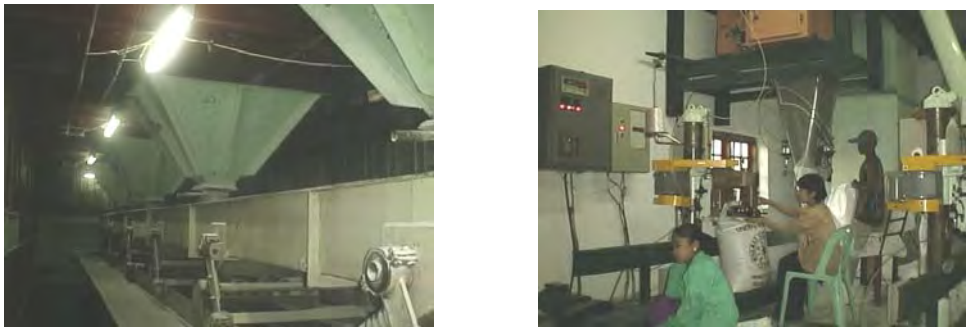

Figure 2-14 :Blending and packing machine

Figure 2-15 :Raw and refined sugar crystal

The weighed and bagged sugar falls to a conveyor and it passes through bag closing machine to close the bagged sugar and then drop to out-loading conveyor. Another bagged sugar weighing scale is also provided for re-checking the weight of bagged

sugar from time to time. Sugar lumps separated by the second vibrating screen is also sprayed with hot water and goes to sugar lumps melter.

2.2.9 COMPARISON BETWEEN CARBONATION AND PHOSPHATATION SUGAR REFINERY MELT CLARIFICATION PROCESSES

Both the flue gas carbonatation process and phosphatation flotation process are used in sugar refining. Both processes represent more or less exclusively the primary melt clarification system used as the first treatment of melted washed raw sugar refinery melt, to clean up the liquor streams prior to the application of further various decolourisation processes. The primary function of both processes is therefore to remove turbidity, suspended solids, polysaccharides, and other colloidal impurities. There is also an added advantage of decolourisation within each of the two processes. Both processes are widely used in the sugar refining industry and either system is equally capable of achieving the necessary operational requirements and performance parameters. The applications and comparisons of each process can be readily assessed and the final selection is dependent upon various factors such as location, sugar type, investment and versatility.

2.2.9.1 Historical spread and use of processes for refined sugar

Flue Gas Carbonatation has been operated in its current format for a long time and is often referred to as ‘traditional’ technology. The Phosphatation process is more recent. Carbonatation is more widely used in the stand alone refineries of Europe, whereas in Asia and Latin America Phosphatation is more common, especially in refineries attached to sugar factories.

2.2.9.2 Sugar manufacture and distribution, and refined sugar manufacture

Total world sugar production at present stands at approximately 135 million tonnes per year. Of this total, around 95 million tonnes is produced from cane and 40 million tonnes from beet. Of the 95 million tonnes of sugar made from cane, some 30 million tonnes is made as plantation white sugar (mainly in India and China), leaving 65 million tonnes being produced as refined sugar from cane raw sugars.

Some 35 million tonnes, of this 65 million tonnes of refined sugar (54% of the world cane refined sugar) is made by the phosphatation process, the majority being made in *"white-end refineries"* at source or in attached sugar facilities and autonomous refineries.

Areas particular to phosphatation are Africa, Australia, South East Asia, North America, Central and South America, and Pakistan where the production is approximately equally divided between the two processes.

Areas particular to Carbonatation are Europe, Middle East, some of South East Asia, some of the America.

2.2.9.3 Economics

The economics of the two processes can be assessed on the basis of two main areas – capital cost (capex) and operational cost (opex). In terms of capex, the phosphatation process is a little cheaper to install, the equipment required being mainly simple tank work, much of which can be locally fabricated. Carbonatation, however requires some more expensive equipment, such as compressors to deliver the CO_2 to the process.

For the Opex, Carbonatation is usually slightly less costly to operate as the primary material used (CO_2) is usually obtained from the boiler flue gases. The two processes are very comparable under many conditions and each will have advantages and disadvantages dictated by local conditions.

2.2.9.4 Optimum selection of type of process

It is more likely that the selection of the carbonatation process would be matched to a larger size refinery, especially autonomous plants, where continuous material flows are expected and maintained year round.

In locations where capacity is smaller, often subject to fluctuations of flow, variation of raw sugar quality and type, or there is a requirement to attach the plant to an existing operation, the phosphatation process is more likely to integrate with these existing operations.

CHAPTER 3

INDUSTRIAL MANAGEMENT SYSTEMS OF SUGAR INDUSTRY OF THAILAND AND MYANMAR

Interviews with qualified authorities in order to collect the relevant information from the industry, which are then used to demonstrate and to supplement the data from the literature review. Finally, the information from these studies will be analysed and summarised in Chapter 4 and 5.

3.1 DEPTH INTERVIEW ENFORCEMENT

The objective of interview is to get information from the experts about the systems of sugar industry of Thailand and Myanmar to create the best practice system for Myanmar. The term “depth interview” has meant a comparatively unstructured one-to-one interview (Proctor 2003). The advantages of depth interviews illustrated below:

- Group pressure is eliminated in order that each respondent reveals more honest feelings
- The personal one-to-one condition gives the respondent the feeling of being the center of attention

- The respondent attains the state of awareness in a personal interview because they are in constant interact with the interviewer and there are no one to hide behind.
- The extra time dedicated to obtain the revelation of new information.
- The respondent can be explored at length to reveal the information that concerns the statements.
- Allows flexibility and new directions of questioning can be improvised which may provide critical insights to the main issue.
- The closeness of the one-to-one situations allows the interviewer to become more sensitive to non-verbal feedback.

The result from depth interview is the summary of the answer from respondents combined. To verify the summary of the depth interview, two experts are introduced to the summary and the correction will be made in this stage (see appendix A).

The information obtained in this step will be illustrated later on in this chapter, and will be analysed in Chapter 4&5.

3.2 SUGAR INDUSTRY SYSTEMS OF THAILAND

New era of the Thai sugar industry began in 1927. The Government set up the first modern machinery sugar factory in Lampang Province with 800 tons cane/day (TCD) capacity and a second in Uttaradit four years later with 500 TCD capacity. Both sugar factories are in the northern region of Thailand. Then in 1956 and 1958 the Government built two more sugar factories in the eastern and central regions at Cholburi and Suphanburi with 1,500 TCD capacity each. Since 1960 Thailand has been able to produce sugar to meet domestic demand.

As a matter of fact that higher sugar prices both domestic and world market induced millers to expand their capacities. The latest statistics shown 2.5 million tons sugar produced from 24 million tons sugarcane in 1985/1986. Volume of sugar export has been increase from 156,000 tons in 1961 to 320,000 tons in 1962, then 426,808 and 1,968,550 tons in 1972 and 1982 respectively. At present Thailand is rank as one of five-top export countries (CSR Sugar, 2006). Currently there are 48 mills in operation with an estimated daily crushing capacity of 677,386 tons (see appendix B). Thailand has no stand-alone refineries all sugar refineries are part of cane crushing mills. As a result, raw material go directly to remelt for refining, and by using power from the mill the refining costs are reduced (www.foa.com).

For the performance of Thailand's sugar industry report on cane sugar production of sugar factories in Thailand during past five years period please see appendix C

Not only Thailand is a sugar self-sufficient country but also a sugar export country. Whenever the sugar industry was impacted due to the lowest world sugar price, both planters and millers were affected by worse incident.

In order to sustain the economic stability and protect interests of planters together with millers in productions and sales of sugarcane and sugar product respectively, they need certain measure in providing an effective system for controlling the productions and sales of sugarcane and sugar products to be in line with such incident.

Subsequently, the sugar industry was depressed because of the lowest world sugar price happened within a period of 15 years. The Government issued the Sugarcane and Sugar Act B.E. 2527 (C.E. 1984) which was the third Sugar Act so as to regulate the sugarcane and sugar industry from cultivation up to export. This Act was jointly drafted by planters, millers and the Government representatives. With the mutual cooperation from every sector concerned, such sugar industry crisis was gradually restorative. The Sugar Act of 1984 introduced a revenue-sharing scheme for growers and mills. Under the scheme, growers receive 70 percent of the revenue from domestic and export sales of sugar and molasses, less costs and taxes, and mills earn the remaining 30 percent. Upon delivery of cane to mills, growers receive an initial payment calculated on a base price negotiated by the government.

For the sake of maintaining the country's economic stability and protect interest of the sugarcane planters in their production and sales of sugarcane, it is considered appropriate to systemize and control the production and sales of sugarcane and granulated sugar produced from sugarcane, requiring the sugarcane planters and owners of sugar factories directly benefiting from it to cooperate with the Government in stages ranging from the production of sugarcane to the division of income derived from sales of granulated sugar in both internal and external markets between the sugarcane planters and owners of sugar factories to enable the sugar industry to grow with stability and for

fairness to all sugarcane planters, owners of sugar factories and the consumer public.

Consequently, in order to take charge of the execution of this Act, the Board and Committees were called for as shown in the following Organization chart follow :

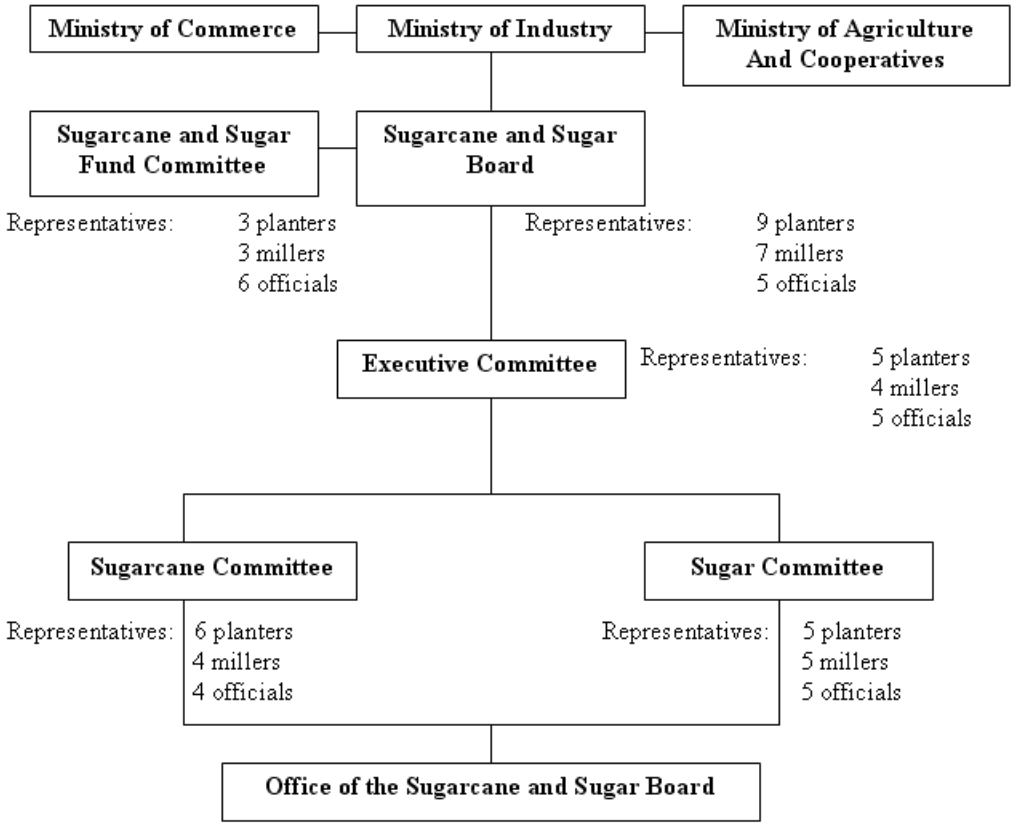

Figure 3-1 : The Organizational Activities of Thailand's Sugar Industry

In accordance with the above organizational activities of the Thailand's sugar industry, the Sugarcane and Sugar Fund was established with the fallowing objectives:

(1) Study, research, development and promotion of production, usage and sales of sugarcane and granulated sugar.

(2) Maintaining the stability of the sugarcane and sugar industry for the benefits of the sugarcane planters and sugar factories and for the country's economic stability.

(3) Maintaining the stability of prices of sugar consumed in the country for the benefits of the consumers.

(4) Executing other tasks to achieve the objectives of the Fund.

Consequently, the Sugarcane and Sugar Act B.E. 2527 was issued by the Government and it came into effect since August 9, 1974 up to now.

The afore-mentioned Sugarcane and Sugar Act B.E. 2527 aims to arrange with the current status of the Thailand's sugar industry about efficient regulations and its structure. Such new arrangement is a must, particularly it should be capable to resist impacts caused by any contradictions between planters and millers or even down-trend of the prices of sugarcane and sugar. To achieve success of the solution, the main paramount principles must be fair allotment of benefits between planters and millers and let them take parts mutually in management of the sugar industry. All these measures are the objectives provided through the Sugarcane and Sugar Board as their specified functions under the organizational activities as follows (Ministry of Industry B.E. 2527):

1.2.1 To devise the plan for planting and production of sugarcane, and production of sugar.

1.2.2 To designate areas suitable for the planting of sugarcane.

1.2.3 To specify suitable varieties of sugarcane crop to be promoted among the sugarcane planters for planting in areas designated by the Committee per (1.2.2).

1.2.4 To devise rules, principles, procedures and conditions for the registration and acceptance of the registration for the institutions of sugarcane planters.

1.2.5 To devise rules of registration of sugarcane planters and leaders of sugarcane planters and leaders of sugarcane planter groups, and the revocation of registration of leaders of sugarcane groups.

1.2.6. To devise principles, procedures and conditions for the activities of the leaders of sugarcane planters groups.

1.2.7. To set quantity of sugarcane to be produced by the sugarcane planters, taking into consideration also the planted areas of sugarcane registered per (1.2.5) and production volume averaged in the past three years.

1.2.8 To devise rules for allocation of supplies of sugarcane to the sugar factories.

1.2.9 To devise rule for the promotion of sugarcane planting, including those for the prevention, control and suppression of sugarcane plant enemies.

1.2.10 To devise rules of the cutting and supply of sugarcane to the sugar factories, and the inspection of quality to sugarcane.

1.2.11 To set the date of the commencement of sugarcane crushing for production of sugar, normal rate of cane crushing per day by each factory, and the ending date of sugarcane crushing for production of sugar.

1.2.12 To devise rules for the acceptance of supplies of sugarcane from the sugarcane planters or leaders of sugarcane planters groups.

1.2.13 To fix types, quality and amount of granulated sugar produced by the sugar factories.

1.2.14 To devise rules for the management of sugarcane or granulated sugar based on the quantity of production set the Committee per (1.2.7) or (1.2.13)

1.2.15 To set rules for dealing with the sugar factories which are unable to produce granulated sugar of the quantity set by the Committee per (1.2.13)

1.2.16 To set rules and methods for dealing with the granulated sugar not meeting the quality standards set by the Committee per (1.2.13)

1.2.17 To set rules for the production, packing, storage, place of storage survey, movement and delivery of granulated sugar and by-products.

1.2.18 To set principles, procedures and conditions of selling granulated sugar for domestic consumption, and selling prices thereof.

1.2.19 To set principles, procedures and conditions of import of granulated sugar is such need arises.

1.2.20 To set principles, procedures and conditions for licensing of export of granulated sugar such principles, procedures and conditions not in any way to favor only one person to engage in export.

1.2.21 To set principles and methods of computing the costs of production of sugarcane and granulated sugar.

1.2.22 To set principles and methods of estimating income, pricing and payment for sugarcane, and value of production of granulated sugar, taking into account the cost of production of sugarcane and granulated sugar, and also the Fund in operation,

1.2.23 To set ratio of the returns on investment between the sugarcane planters and sugar factories, taking into account the whole income derived from sales of granulated sugar and by production of sugar will be based.

1.2.24 To set fees for research and promotion of production of sugarcane and granulated sugar, and devise mode of payment of fees and others benefiting the institutions of sugarcane planters.

1.2.25 To devise rules of the payment of fines and rewards for persons who lead to the arrest of offenders or violators of the rules or announcements of the Committee.

1.2.26 To devise rules of the expending in the control of production of sugarcane and granulated sugar, sales, importation and exportation of granulated sugar.

1.2.27 To devise rules of hiring employees with payment from the Fund.

1.2.28 To set remunerations for the various committees functioning under this Act, except the Sugarcane and Sugar Board.

1.2.29 To perform other functions as prescribed by the low, or assigned by the Cabinet.

1.2.30 To devise any other rules for acting in compliance with this Act.

3.3 SUGAR INDUSTRY SYSTEMS OF MYANMAR

Myanmar is the biggest country in terms of area in Southeast Asia - 676,577 square kilometers with population of around 55.4 million people (2005) see appendix D. Its agriculture sector contributes 45.3 % of GDP, 10.6 % of export earning and employs 63 % of the labor force. Economically, therefore, Myanmar is an agricultural country. The principal crop are paddy, sugarcane, cotton, maize, ground nut, sesame, sunflower, black gram, green gram, and pigeon pea.

Myanmar has potentials of land, water and labour resources and considerable experience in sugar industry. Myanmar is the most favourable country to step up its sugar industry development, while other many of the sugar producing countries are facing limitation.

Nowadays, many countries are focusing on the production of gasohol and bio-diesel, due to increasing limitations on the availability of fuel and its high price. It is important to mention that the status of ethanol production in Brazil, the highest exporter of sugar. Annually Brazil utilizes up to 50% of its total sugarcane production in the direct production of ethanol, while remaining the other 50% of cane goes for sugar production. Thailand, one of the high exporters of sugar, is presently producing gasohol with its own ethanol produced from molasses and imported ethanol and is looking forward to the produce of ethanol direct from sugarcane.

PRESENT STATUS OF MYANMAR SUGAR INDUSTRY

Sugar industry of Myanmar has been initiated since the day of Myanmar Kings and the Modern sugar mills have been introduced first with the establishment of Namatee Sugar Mill and Pyinmana Sugar Mill in 1957, seven modern sugar mill in total existed up to 1998. With the intention to promote the development of Myanmar sugar industry, Government of Myanmar decided to expand 10 new sugar mills and three private sugar mills in 1998, as a result, the total of 20 modern sugar mills has been existed in the year 2008 **(see figure 3-2)**. The total crushing capacity of the 20 sugar mills is 5.5 million MT cane per season but due to shortage of available cane to the mills, all seasons in the past the sugar mills could not run at full capacity and producing sugar based on the available cane. See the sugar cane production and milling progress reports in appendix E

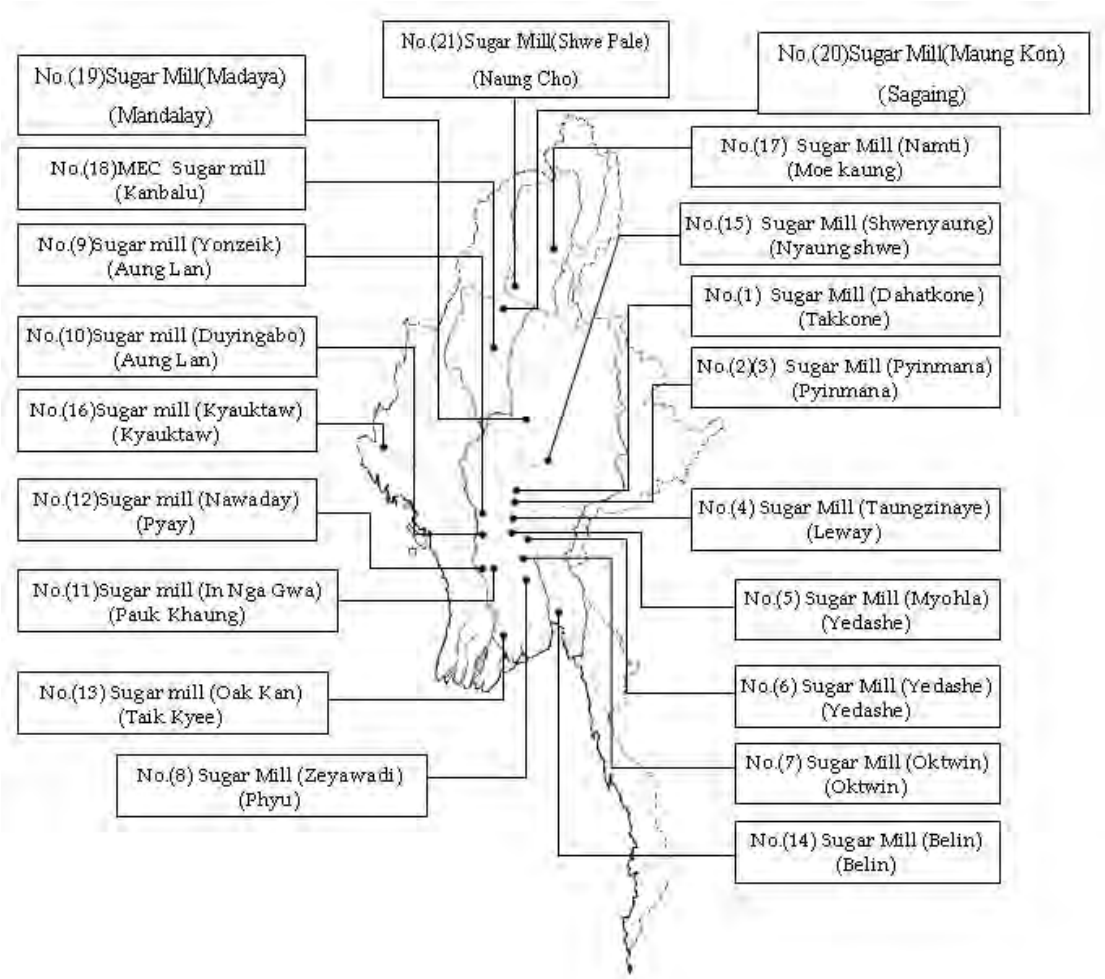

Figure 3-2 : Sugar mills in Myanmar

REQUIREMENTS FOR THE DEVELOPMENT OF MYANMAR SUGAR INDUSTRY

It is important to get a balance between two main factors, the one as sufficiency of raw material sugarcane and the other as sufficiency of sugar mill, for the development of the sugar industry. The sufficient requirement of sugarcane as the raw material for the existing 20 sugar mills to meet their full capacities, being 5.5 million MT, the minimum requirement of cane area accessible to the sugar mills should be 300,000 acres, from which the average net delivery of 25 MT/ac after deduction of seed cane.

The key factor for the expansion of cane area additional 200 thousand acres in all 20 sugar mill areas or roughly of 5 to 15 thousand acres in each sugar mill area is to let the willingness grow among local cane growers to expand their individual cane areas. If private companies or investor groups with ready investment and technology could be organized and encouraged to participate in contract farming for cane cultivation, level of cane requirement by the sugar mills shall be accomplished speedily in a short time (U Soe Myint, a sugarcane expert at Myanma Sugarcane Enterprise (MSE),2008)

In fact, sugar industry, being the long term partnership between the raw material providers, the cane growers and the producers of finished product, the millers, it is important to build up the mutual trust between the two parties on the basis of sincere and friendly cooperation towards mutual profits.

The importance in the attempt of getting enough cane supply to the sugar mills, is to let the cane growers get a competitive cane price, due to the facts on the nature of the sugarcane crop that the crop could fetch its income only once a year, and on the other hand, cultivation cost stands higher than other seasonal crops, demanding powerful tractors and appropriate implements to speed up land preparation works on top of the traditional draught power and requiring higher seed rate and big volume of cane seed to expand new area.

SUGARCANE CULTIVATION COST & CANE PRICE

Thus the Government allocated sizeable area of land out of the available waste and fallow land to the interested national entrepreneurs, starting from 1998, to encourage the development of major crops including sugarcane to come up in the form of large

farms. Though some sugarcane plantation farms under such encouragement have been established, due to continued loss, they came to the total stop by now, the main reason being lack of economic viability. The said national entrepreneurs have to bear all the expenses, starting from land clearing and land development operations to the harvest of the crop at the market rates and prices with no possibility like small holders to compensate some costs with their own family labour and they have to leave the business when their cost of cultivation could not be justified with their sale income from the cane at the yearly fixed cane price. As for the local individual cane growers, some continue growing the crop through minimizing their cost by putting more family labour, while some leave the crop and go for other crops, which can fetch better price and income.

Sugarcane was purchased by Government sugar mills at yearly fixed price. In private sector, there was no direct sugarcane market and price, since private small sugar mills are using native syrup and cane jaggery as raw materials and dealing with the raw material market and price rather than direct dealing with cane price. It is the common practice in the cane field that majority of cane growers tend to switch to boiling native syrup or jaggery from direct cane delivery to sugar mills, when the Government cane price went too low under the reasonably fair price. With the good intention of State for better efficiency of the business, though the management of existing state owned 18 sugar mills was shared among MSE, Industry 1, MEC, Eco. Holding, Kachin Group and JV, fixed pricing system, in the area of cane purchase still remains functioning as in the past and free market price system was prevailed by 2004.

Yearly cane price of sugar mills is given as follow:

Table 3.1 : Myanmar Sugarcane Price Statistic

YEAR	SUGARCANE PRICE KS/MT	EQUIVALENT US$ PRICE ACCORDING TO YEARLY EX-CHANGE RATE
1996-97	1500	10.20
1997-98	1850	8.85
1998-99	2500	7.86
1999-00	2500	7.25
2000-01	2600	6.25
2001-02	3500	5.00
2002-03	4200	4.20
2003-04	4200	6.67
2004-05	6000	7.45
2005-06	8000	8.0
2007-08	15000	12.5
2008-09	15000	15

Sugarcane crop, by its nature could be viewed to own both advantages and disadvantages as compared to other field crops as- disadvantages being (1) high cost of cultivation (2) requirement of high seed rate and taking time to expand new crop area (3) needing machine power (4) crop income only once a year and as advantages (1) it can thrive well in almost all soil and land situation (2) hardy (3) it doesn't abandon its owner even in severe drought years and pay some income, while all other crops at complete loss (www.fao.org). (4) market is assured.

SUMMARY OF SUGAR INDUSTRY SYSTEMS OF MYANMAR

The main cause of ailness in Myanma sugar industry is the shortage of cane supply to the sugar mills. The related cause of shortage of cane supply is due to normally the very low cane price, which is fixed by the State periodically. Though cane price is periodically reviewed and adjusted as required, normally increase of cane price comes too late and is not encouraging to the cane growers. The expectable profit of growing sugarcane in unit area of land in a season is not competitive to the profits expectable from farming other crops, since other crops can enjoy open market prices, while cane is to be sold under the fixed price. To this effect, in areas where native syrup and jaggery making is possible, cane area is increasing while in sugar mills areas, cane area is reducing.

To correct this situation, the state, in early 2004, granted the liberalization of free trading of industrial crops including sugarcane and also relocated the management of the existing State-owned sugar mills from single government organization to few

government organizations and some capable economic bodies like MEC & Eco Holding of the Government, with the good intention to improve the efficiency.

But, regarding cane purchase price, there is no sign of improvement up till now and the concerned agencies, managing the sugar mills are found to follow the cane purchasing system with Government fixed price like in the past.

It is to be viewed that there is the need to establish more trust between cane growers and the sugar mills, with mutual understanding, transparency, and mutual benefit in long term partnership.

Thus through cane area expansion with assured benefit of the crop, yield increase with good care to the crop and transformation of existing inefficient system of traditional boiling of native syrup and jaggery into improved modern system, by saving present national losses, the performance of the existing sugar mills can be improved by getting enough cane and crushing at full capacity.

It is learnt that there is the emergence of private modern sugar mills using sugarcane as the direct raw material in 2004 and the business is running with success, crushing at full capacity with enough cane supply to the mills purchased at free market price, with no problem of shortage of cane supply to the mills.

CHAPTER4

ANALYSIS AND DISCUSSION

This chapter presents an implementation of Porter's Diamond and Five Forces Model. Ideal case is used to illustrate good practice of sugar factory and ways in which the factory can be improved. The information from this Ideal case will be analysed and summarised to supplement the literature review and help formulate the discussion and the key findings of this paper in Chapter 4 and 5.

4.1 PROS AND CONS OF SUGAR INDUSTRY SYSTEMS OF THAILAND AND MYANMAR

PORTER'S DIAMOND MODEL FOR THE COMPETITIVE ADVANTAGE OF NATIONS

Thailand and Myanmar are potential countries in Sugar manufacturing and also be a competitor to each other in Asian Community. In order to compare advantage of landscape and external factors between these 2 countries, Porter's Diamond Model will be used as Figure 4-1

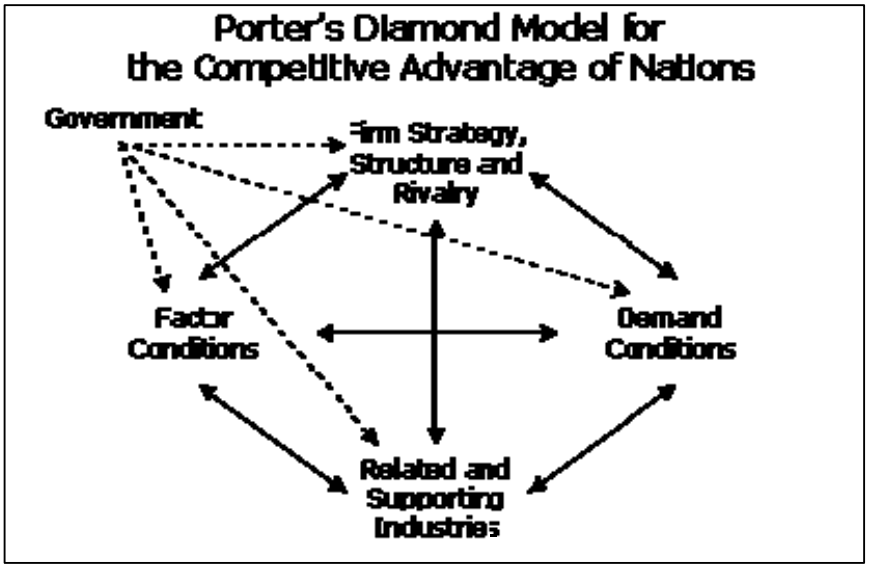

Figure 4-1 Porter's Diamond model (Source: www.valuemanagement.net)

The frame of analysis will focus on these points:-

1. Factor condition such as natural resource, labor, and technology
2. Demand condition
3. Firm strategy structure and rivalry
4. Related and supporting industries
5. Government support

The Diamond Model of Michael Porter for the competitive advantage of Nations offers a model that can help understand the comparative position of a nation in global competition. The model can also be used for major geographic dimension that result in economic review of Sugar export countries. The Diamond is useful for competition evaluation of Thailand and Myanmar and able to use as primary information to scope frame of comparative analysis in sugar industry in the future.

DIAMOND MODEL ANALYSIS

Factor conditions

Traditionally, economic theory mentions the following factors for comparative advantage for regions or countries:

1. Location
2. Natural resources
3. Labor
4. Technology

Porter says that sustained industrial growth has hardly ever been built on above mentioned basic inherited factors. Abundance of such factors may actually undermine competitive advantage. He introduces a concept called "**clusters**" or groups of interconnected firms, suppliers, related industries, and institutions that arise in certain locations. See comparing table between Thailand and Myanmar in **Table 4.1**

Table 4-1 Factor comparative advantage

Factors	Thailand	Myanmar
Location	Basic infrastructure in Thailand such as electricity, water and others are in good quality. These infrastructures are provided by Thai government which aims to lift up quality of people's life and support industrial in every level. Express ways and local roads are good and convenience for inland transportation which is benefit for short distance transport from factory to port and from farm to factory. Location of existing sugar factories mostly is nearby sugarcane fields.	The sugar factory location is not stipulated in its license about a distance to other sugar factories. Some of them are close to the other. However, sugarcane in those areas are allocated for milling. Many sugar factories in Myanmar situate near rivers and railroads but in practice they cannot utilize them for any transportation
Natural resource	Generally, the plane areas in central region are fertile. The yearly rainfall is about 50 to 80 inches in central region, while in northern is about 40 inches. Most of sugarcane supplied to sugar factories came from rain-fed areas, though some of them came from irrigated areas.	Myanmar is still relatively rich in water resources as compared to other neighboring countries. The four principle rivers, viz. the Ayeyarwady. Chindwin, Sittaung, Thanlwin and Mekhong River. Their total annual inflow is estimated to be 876 million area-feet, while their drainage areas are also spread widely over the country (see appendix F). The existing records in Myanmar indicated that about 4 million acres of crop land are irrigated and the amount of water use stands around 6% of the total available water inflows of the country. All the potential irrigable area of Myanmar, which is estimated to be around 10.5 million hectares, are subject to irrigation, the total water use for irrigation will still be just 25% of the total water resources of

Factors	Thailand	Myanmar
Natural resource		-the country. In the case of land resource, there are still large agricultural areas under cultivable waste land available. Myanmar is well endowed with mineral resources and has many famous mines. To explore, develop and exploit the mineral resources of the country and to make partnership in bilateral co-operations, the Ministry of mines welcomes the foreign investors interested to invest in joint ventures with the economic enterprises under the Ministry. The production of precious stone, such as gems ruby jades and diamonds as handled by another State Enterprise. The main minerals produced are refined lead, refined silver, zinc concentrate, copper concentrate, refine tin , tin concentrate, tin-wolfram-scheelite concentrate and gold. Petroleum offshore concessions were more fruitful than onshore. Premier Consolidated Oil company struck gas which is now to be piped to Thailand by pipeline in association with Texaco and Nippon Oil. Total in association with UNOCAL have agreed to transport natural gas to Thailand

Factors	Thailand	Myanmar
Labour	Labor wage in sugarcane field is in the range of 160-200 Baht/working day Lack of labor for sugarcane harvest and loading on trucks Sugarcane loading on trucks by mechanized stackers is more favorable than manual at present	Labor wage in the case of Myanmar for the same working is around 1-1.50 USD. Hence, it is easily to hire them at low cost. Farm mechanized equipment is rarely available to use in sugarcane farming. Weed control in sugarcane field is carried out by manual.
Technology	Thailand has “Office of the Cane and Sugar Board” which is an organization that educate and training. The major sugar program involves the development of new cane varieties with high tonnage, high sugar content and resistance to diseases, land preparation, new cultivation techniques and method of controlling pests and diseases. This advance infrastructure supports Research & Development in Thai sugar industry. Such development of new varieties results in Thailand having new cross-bred varieties so as they can be distributed to Thai sugarcane planters including Myanmar planters. Such varieties are the following example ones sent to Myanmar K 84/200, K88/92, K84/69 K 92/181, K 91/2-056 K BS 94/13, K 95/84	Already existed, a fair source of skilled engineers and chemists available Most of sugar factories do not plant sugarcane by theirown. Only 10-25% of them having theirown sugarcane field. In sugarcane farming still use oxen for ploughing, thus resulting in less depth of ploughed soil (only about 10 inches), while the distance of sugarcane planted is only 90 cms. So it is hard to carry out weed control, resulting in the decrease of sugarcane yield including its quality.

Factors	Thailand	Myanmar
Technology	K 95/283 Mechanized farm equipment is more favorable by Thai planters who have sugarcane farms of big size Distance between each sugarcane planting row is developed to 1.7 meters so as to facilitate the mechanized farm equipment working in the farms. - Both sugarcane yield per hectare and sugar yield % cane increase by implementing developing technology of the sugarcane farming, simultaneously such practice can decrease the cost of production e.g. the chemical fertilizer is replaced by the compost fertilizer made from filter cake	

Porter's Five Forces Model

Five Forces Analysis is framework for industry analysis and business strategy development developed by Michael E. Porter in 1979 of Harvard Business School. The purpose of Porter (1998)'s five competitive forces model is to give the overview of an organisation's position in the market. They consist of those forces close to a company that affect its ability to serve its customers and make a profit. A change in any of the forces normally requires a company to re-assess the marketplace. However, to examine the competitive forces in detailed, it is important to understand the nature and sources of those factors (Porter 1985). The competitive forces of collaboration between XYZ CO., LTD. can be analysed in a context of business and marketing as following:

1. The threat of substitute products
2. The threat of the entry of new competitors
3. The intensity of competitive rivalry
4. The bargaining power of customers
5. The bargaining power of suppliers

Each of these forces has several determinants in **Figure 4-2**

Figure 4-2 :Porters Five Forces Model

Comparing advantage and disadvantage between Thai sugar industry and Myanmar sugar industry item by item as followed

- **The intensity of competitive rivalry**

This element describes an intensity of the competition among existing players (sugarcane factory) in an industry. The competitors of between ABC & XYZ CO., LTD. are all other similar products in different factory both national and international, considerably low competitive pressure due to there is no competition for finding raw material.

- **The threat of entry of new competitors**

The competition in this agro industry will be lower and harder for other companies and factories to enter this field. However, it would also be limited depending on some barriers. In this case political risk in Myanmar is the major factor to consider, it would be very difficult for the new entrants. Scarcity of resources such as qualified expert engineers and staffs is another barrier, since this is one of the first priorities that one should have.

- **The threat of substitute products**

The threat of substitute would only exist if there were an alternative product with lower price and equal reputation, or there is a significant decrease in demand for the field that ABC & XYZ CO., LTD. is operating in. Hence, this element of threat is considerably low.

- **The bargaining power of suppliers**

The term supplier comprises of all sources for inputs that are needed in order to provide goods or services. ABC & XYZ CO., LTD.has close relations with many business support organisations, government agencies at local, regional and national level that would help in terms of dealing with suppliers. In addition, the suppliers for ABC & XYZ CO., LTD. are the farmers and staffs who are working in contribution to the group. Hence, this bargaining power would depend on the price of sugarcane, which ABC & XYZ CO., LTD. proposes the price at competitive rate.

- **The bargaining power of customers**

The buyer in this case is customers who are interested in the products. The quality of the company or the brand and substitute products will be the main factors that customer has to consider. Hence, the bargaining power is low.

4.2 IDEAL CASE

4.2.1SUGAR FARMING:

It is a well-known fact that the cane sugar is manufactured by sugarcane plant while a sugar factory carries out a sugar processing for commercial sugar products. Thus the quality of the cane supplied to the sugar factory has to be of high sugar content or high sugar yield.

With respect to an ideal sugarcane farming, such sugar content or in other words the sugarcane quality has a powerful influence on the cost-effective of sugarcane farming investment and it should say including the same of a sugar factory too. That is why the sugarcane farming together with the sugar factory project is a must to be of ideal case.

In order to achieve the sugarcane farming of ideal case, the following main factors concerned should be carried out:

- Selecting sugarcane seed varieties of three categories for sugarcane farming i.e.:

    - Short-maturity varieties for early milling period which develop the peak of sugar content during such period. The short-maturity varieties have their ages from planting up to harvesting between 8 and 10 months.

- Medium-maturity varieties for intermediate milling period which develop the peak of sugar content during such period. The medium maturity varieties have their ages from planting up to harvesting between 11 and 12 months.
- Long-maturity varieties for late milling period which develop the peak of sugar content during such period. The long-maturity varieties have their ages between 12 and 14 months.

- Applying an effective system of irrigation for the sugarcane farming by considering reliable comparative practical data as the following example:

Irrigation system	Yield: Tons Cane/Hectare	Water Use Efficiency
(1) Conventional drip (Trickling)	94	0.703
(2) Ridge-and-Furrow	80	0.545
(3) Automatic drip	103	0.287

The sugar yield of sugar was also found to be 4.39 tons sugar/hectare higher in sugarcane grown using the automatic drip system than in cane grown using conventional irrigation. Moreover, it gave a 25% saving in fertilizers. Pressure compensation drippers and in-line-drip irrigation gave about 20% higher yields of sugarcane, 2 to3 tons/hectare more sugar and 2 to 2.5 times higher water use efficiency.

- Combating sugarcane diseases in the sugarcane farming is one of its ideal farming management. The existence of excellent genetic does not guarantee

by itself, production increase since physical factors such as climate and soil and biological factors, e.g. diseases and pets, can condition the production potential. Ratoon stunting disease (RSD) alone can be pointed out as the cause of losses of up to 20% in pol, and consequently of the sugar in the affected areas.

- Applying entomological control because certain insects can also reduce drastically the gain of sugar from sugarcane.

- Utilizing mechanization which can solve a problem about the migratory process of rural workers for the carrying out of field operations. The cutting, loading and transport, which as a unit, represents about 40% of the total production cost of the sugarcane depending on the distance between a sugarcane field and a sugar factory.

4.2.2 SUGAR FACTORY PROJECT

Generally, before launching any sugar factory project, the selection of the site of a project sugar factory has to be first based on complete survey of pros and cons of various geographical areas and, ultimately, the same of available real estate which can have strong impact in the success of an industrial venture.

The paramount factor is the location where the ideal sugar factory erected, particularly the sugar factory must refer to the sufficient tract of land planned for expansion of its production capacity and utilization of its by-product projects in the future. Other utmost importance factor is that such premises must be in the center of sugarcane fields where its radius should not exceed 100 kilometers so as to minimize transportation cost of raw material, consumables including sugar products and by-products resulting in the decrease of the production cost and expediting sugarcane supply or reducing downtime.

The next factors concerned the ideal sugar factory at an inception period are the professional standards' responsibilities and certified quality management e.g. "Certified Quality Management (ISO 9001) and Hazard Analysis and Critical Control Point (HACCP)" system. These factors can indicate and certify the Project Works that they were put into the international standards.

“ISO 9001” is a model of standard series under international agreement on relations devised for leading system of the quality management for which can be proved by independent organizations. ISO 9001 shall instruct the quality system involving the quality assurance of design, development, production, installation and services. Such model’s objectives are of the following :

- To ensure in the quality control of production and services.
- To work correctly from then till now.
- To examine problems, identify, correct and prevent them.
- To improve the company goodwill.
- To satisfy customers, maintain them and increase them
- To utilize human resource’s efficiency.
- To reduce cost of production by reducing losses, repeated works and unqualified products.
- To enhance employees’ morale and their will-power, in their workings, in the case of ones who took part in improvement.

“Hazard Analysis and Critical Control Point” system (HACCP-system) is devised to take care for the safety of all persons entitled to be on the site so as to avoid hazard to these persons. The project to be ideally launched shall comply with applicable safety regulations as follows:

- to keep the site and works clear of necessary obstruction so as to avoid hazard to these persons.
- To provide fencing, lighting, guarding and watching of the works until completion and the Project’s owner taking over.

- To provide any temporary works including roadways, footways, guards and fences, which may necessary, because of the execution of the works, for the use and protection of the public and owners and occupies of adjacent land.
- To ensure that emissions, surface discharges and effluent from the Contractor's activities shall not exceed the values indicated in the Employer's requirement, and shall not exceed the values prescribed by applicable Laws.
- To minimize emission of CO_2, SO_2 and particulates to the atmosphere.
- To reduce noise level to the minimum.
- To dispose all hazardous and non-hazardous waste to the permitted landfill site.
- To make the working environment litter-free.
- To emphasize to all employees the benefit of friendly environment.
- To take all responsible precautions, all time, to sustain the health and safety of the Contractor's personnel.
- To ensure that medical staff, first-aid-facilities, sick-bed and ambulance service with emergency aid male nurse are available at all times at site and at any accommodation for Contractor's and Employer's personnel, and that suitable arrangements are made for all necessary welfare and hygiene requirements and for the prevention of epidermics. Those things mentioned above are agreed to collaborate by local health authorities.
- To appoint an accident prevention officer at the site, responsible for maintaining safety and protection against accident. This person shall have

the authority to issue instructions and take protective measures to prevent accidents.

- To provide whatever, throughout the execution of the works, is required by this person to exercise this responsibility and authority.
- To hand in details of any accident to the engineers as soon as practicable after is occurrence.
- To maintain records and make reports concerning health, safety and welfare of persons, and damage to properly, as the engineer may responsible require.

Apart from the afore-mentioned factors indicated the property of the ideal sugar factory, the following characteristics and practices of individual activities are also the property of the ideal sugar factory in the same manner :

A. Milling House :

- To utilize the digital control system (DCS) for controlling the factory performance, not only at milling house but also at the other activities e.g. process house, power house and boiler house.
- Using cane knives of hard surface, self-sharpening and reversible type.
- Utilize high enclose gravity feed chutes which can create the longitudinal pressure at the mill rollers caused by the weight of the feed in the chute which would be in the order of 0.8 psi. approximately.

- Using feed hopper level control system interconnected to the speed control of the prime movers of the mills and intermediate carriers.
- Equipping heavy-duty feeder, light-duty feeder and under-feeder of which can enhance the mill feeding efficiency as well.
- Using self-setting or constant ratio mill and six-roller mill installed for the first mill of the tandem.
- Roughening the mill roller surface with electric welding electrodes.
- Each mill is driven by independent steam turbine.
- Utilize hot imbibition (85 ± 2°C) system so as to maintain better sanitary at the mill tandem and reducing bagasse moisture for more complete combustion in boilers and more surplus bagasse for carrying out cogeneration smoothly.

B. Process House :

- Using hot liming for mixed juice clarification under two-point liming control system or an automatic pH correction system instead of the conventional cold liming system.
- Modifying the juice feeding compartment of a clarifier to create laminar flow instead of turbulent flow.
- Using locally modified juice strainers of stationary and rotary type for mixed juice and clarified juice.
- Using locally modified floatation phosfatation process for clarifying the cane mud filtrate so as it can be sent directly to evaporators.
- Utilize vapor bleeding system for more effects in an evaporator tandem, reducing exhaust steam and condenser water consumption.

Simultaneously, it renders more surplus bagasse for cogeneration and various projects of utilization of by-products.

- Using a pre-evaporator for breeding vapor to vacuum pan station.
- Applying a triple seed system in three-boiling system so as to eliminate an affination process before melting raw sugar for refinery.
- Equipping mechanical pan stirrers for improving massecuite circulation and reducing its boiling time resulting in the increase of sugar recovery and sugar quality.
- Using and automatic pan boiling control system for low-grade seeding massecuite.
- Equipping horizontal continuous pans for low-grade and high-grade massecuite.
- Using vertical continuous C-crystallizers with start-stop alternately operating stirrers.
- Equipping fully-automatic centrifugals for high-grade massecuite and continuous centrifugals for low-grade massecuite of which can monitor appropriate sequence of centrifugal operations in their batteries.

C. Boiler House :

- Equipping variable speed control motors for automatic control bagasse feeders. Steam pressure and the load limit of each boiler can be automatically controlled by the correction between the bagasse feeding rate and the combustion air supplied.

- Applying three-element automatic control system for the boiler feed water.
- Installing dust collectors of multicyclone type with water deal device so as the ash can be flushed out by water to an ash collection pond where it can be separated from the water in due course.
- Using make-up steam and desuperheated as low pressure steam originated from the main line high pressure steam which has already passed through a pressure reducing valve and a desuperheater before being used, making up for insufficient low pressure steam.

D. Power House :

- Installing the combined unit type or the central type which can be synchronized together for distributing the electricity and this system can be used in conjunction with the outside system. The main electricity lines are divided as follows :

  High voltage for 3300/6000 Volts, 3-phase and 50 Hz. Distribution to electric motors which require a big load, such as the cane knife motors.

CHAPTER 5

CONCLUSION AND RECOMMENDATION OF FURTHER STUDY

This chapter functions to remind the research purpose and the research questions from the introduction and discuss how the work has answered the proposed questions. In addition, conclusion of the study and recommendation of further study are presented.

5.1 CONCLUSION

After visiting sugar factories in Myanmar and interviewed some Myanmar agronomists and sugar experts and studying thoroughly on the problems of investing in a sugar factory in the form of Joint Venture between XYZ Engineering Co. and Associates of Thailand and ABC Sugarcane Enterprise of the Government of Myanmar, we came to learn that the main problem why the JV project is not successful at all is because of the **shortage of sugarcane** throughout the 11 years sugar campaign since the factory was put up. The JV has been milling only 30% less of the target capacity and this is due to the following reasons:

1) Land Policy – the Government owned the entire land. They just allow the farmers to grow agricultural products which most areas are paddy field which is their Government policy priority . This hinders the farmers to grow other products, otherwise, the Government will get back the land.

2) Price Policy – The Government has set a low price on the sugarcane in the beginning for the first 7 years. Even though the present price is right, the farmers were affected because they have no incentives due to the previous price.

3) Banking Facilities – the Government/banks do not support credit to the farmers. So the farmers do not have enough funds to grow sugarcane. And the banking interest rate is 17% per annum.

4) Size of the Land - the farmers grow sugarcane in a very small area.

5) Farm Equipment – the farmers have no financial strength to buy farm equipment for cultivation, instead, they use cows/buffalos.

6) Irrigation – most areas are not irrigated. Even those areas that are near the irrigation have no small canal for water distribution.

7) Law – there is no law or act for the sugar industry to protect the investment.

8) Export Tax – In the beginning, there is no export tax required. Only lately that the Government imposed an 8% export tax which is a big burden to the sugar industry.

In connection to the given reasons, in the long run, Myanmar is still a suitable location for investing in the sugar industry for domestic consumption and especially for export, because of land availability, cheap price, low wages for the laborers and there is enough water supply as the rainfall is 40-80 inches rain in sugarcane areas. And moreover, the infrastructure will improve in the future.

Thus, the above-mentioned reasons should be solved in order to make the JV project successful, as well as other future projects. In general, Myanmar is really a good location to develop and invest in the sugar industry, and it is even more competitive than Thailand.

After we are convinced that Myanmar is a good location for the investment of sugar industry for domestic consumption and for export, we should try to approach and workout with Myanmar Government and point out the weaknesses as well as to recommend on how to improve certain areas as follows:

1) Lift the 8% export tax.

2) The Government should provide banking credit facilities and lower down the interest rate to the farmers in the beginning and support on the farm mechanization on service terms.

3) To relax the paddy field of 10 miles around the factory to grow sugarcane. Each factory requires 5,000 – 15,000 acres only, depending on the factory capacity.

4) The Government should provide diesel and fertilizers to the farmers on a Government rate until the farmers can manage on their own.

5) The Government should encourage foreign investors to invest in JV to produce sugar mainly for export.

6) The sugar terminal should be suitable for a bigger capacity for export.

These are the ideas and recommendations. The one should make more follow ups and make further study.

5.2 RECOMMENDATION OF FURTHER STUDY

This research was based on the general review of sugar system of Thailand and Myanmar and Depth Interview with qualified authorities. For further research studies, the area could be support with more available resources and more time and effort could be spent carrying out the research. The following are the suggestions for further work:

- Increase the boundaries of research. The larger amount of literature and more variety industry sectors could be conducted to elevate the reliability of the results.
- Focus the scope of the research to a particular topic and specifically in depth study of the topic that could include mathematical models and costs involved in constructing sugar factory.
- Develop a verified framework for designing effective and competitive sugar refinery model to provide a standard for such a procedure.

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APPENDICES

APPENDIX A

Interview Questions

The questions being interviewed with the qualified authorities who had been working in the sugar refinery are as follows:

1. How difference the sugar industry system of Thailand compare to Myanmar?
2. What is the pros and cons of sugar industry of Thailand?
3. What is the pros and cons of sugar industry of Myanmar?
4. How might sugar industry in Myanmar can be improve in term of sugar factory, sugar farming, government policy, and etc?
5. Build the best practice of sugar factory.

Respondent List

1. Dr. Kyi Win, Retired Director General, Department of Agricultural Planning, Ministry of Agriculture and Irrigation,Union of Myanmar

2. U Chit LWin, General Manager, Myanmar Sugarcane Enterprise, Ministry of Agriculture and Irrigation, Union of Myanmar

3. U Soe Myint, Sugarcane Agronomist, Ministry of Agriculture and Irrigation, Union of Myanmar

4. Mr. Watana Chomchan, Process Expert, ABC Sugar Enterprise, Union of Myanmar

5. Mr. Samchai Tippayaart, Former: Director of Sugar Institute of Thailand, Present: Sugarcane Development Managing Director, Mitr Kasetr Sugar Factory

6.Mr. Adul Phongphua, Sugarcane Breed & Experimental Station, Cane and Sugar Industry Promotion Center Region 1, The Office of the Cane and Sugar Board (OCSB), Ministry of Industry, Thailand

7. Mr. Malcolm Wallis, Sugar Processing Engineer, Fletcher Smith Ltd, United Kingdom

The result from depth interview is the summary of the answer from respondents combined. To verify the summary of the depth interview, two experts are introduced to the summary and the correction will be made in this stage

Approved by

1. Mr. Merv Sweetenham, Sugarcane Milling Expert, Walkers Limited, Australia

2. Mr. Santi Chaitragool, Sugar Process Specialist, XYZ Co., Ltd., Thailand

APPENDIX B

	FACTORY NAME	MILLING CAPACITY	
1.	Mae Wang Sugar Industry	2,950	Tons/Day
2.	Uttaradit Sugar Industry	2,683	Tons/Day
3.	Thai Identity	18,000	Tons/Day
4.	Phitsanulok	11,994	Tons/Day
5.	Kampangpetch	8,000	Tons/Day
6.	Nakornpetch	24,000	Tons/Day
7.	Ruamphol Nakhonsawan	8,800	Tons/Day
8.	Kaset Thai	40,000	Tons/Day
9.	Thai Roong Ruang Industry	24,000	Tons/Day
10.	Pranburi	7,000	Tons/Day
11.	Rajburi	12,000	Tons/Day
12.	Ban Pong	9,131	Tons/Day
13.	Mitr Kasetr	11,890	Tons/Day
14.	Thai Sugar Mill	11,764	Tons/Day
15.	New Krung Thai	8,385	Tons/Day
16.	Karnchanaburi Industry	14,447	Tons/Day
17.	Tamaka	18,038	Tons/Day
18.	Prachuap Industry	9,131	Tons/Day
19.	Thai Multi - Sugar Industry	9,635	Tons/Day
20.	Thai Sugar Industry	4,228	Tons/Day
21.	Mitr Phol	21,511	Tons/Day
22.	U-Thong	17,731	Tons/Day
23.	Singburi	11,000	Tons/Day
24.	Saraburi	22,970	Tons/Day
25.	T.N. Sugar	18,000	Tons/Day
26.	Cholburi Sugar	6,838	Tons/Day
27.	New Kwang Soon Lee	6,479	Tons/Day
28.	Cholburi Sugar & Trading	5,800	Tons/Day
29.	Eastern Sugar	17,978	Tons/Day
30.	Rayong	5,560	Tons/Day
31.	Burirum	12,000	Tons/Day
32.	Saharuang	14,000	Tons/Day
33.	Kaset Phol	10,211	Tons/Day
34.	Kumphawapi	12,000	Tons/Day
35.	Rerm Udom	20,582	Tons/Day

FACTORY NAME	MILLING CAPACITY
36. E-Saan Sugar Industry	15,000 Tons/Day
37. Mitr Kalasin	20,000 Tons/Day
38. Khon Kaen	20,400 Tons/Day
39. Mitr Phu Viang	20,000 Tons/Day
40. United Farmer & Industry	18,000 Tons/Day
41. Korach Industry	24,000 Tons/Day
42. Angvian	36,000 Tons/Day
43. Khonburi	13,690 Tons/Day
44. Wangkanai	15,453 Tons/Day
45. Surin	16,000 Tons/Day
46. Erawan	8,117 Tons/Day
Total	665,396 Tons/Day

APPENDIX C

REPORT ON CANE SUGAR PRODUCTION IN THAILAND

CROP YEAR 2007/2008

SEASON ENDING VERSION

Factory Name	Opening Date	Closing Date	Operated Day	Ton Cane Crashed (Tons)			C.C.S.	REFINED SUGAR			RAW SUGAR			Other Sugar	Grand Total	Sugar/ Ton Cane	Final Molasses	Final Molasses/ Ton Cane
				Cane	Burnt Cane	Total		White Sugar	Refined Sugar	Total	Bulk	Bag	Total	Ton	Ton		Ton	
North Region																		
Mae Wang Sugar Industry	11/12/50	1/4/51	113	63,742.995	198,043.775	261,786.770	12.35	60,030.00	0,000.00	60,030.00	21,988.957	0,000.00	219,889.57	0,000.00	279,919.57	106.93	11,259.000	43.01
Uttaradit Sugar Industry	2/12/50	17/4/51	138	88,733.890	283,076.970	371,810.860	12.81	147,676.50	0,000.00	147,676.50	26,326.730	0,000.00	263,267.30	0,000.00	410,943.80	110.52	11,901.700	32.01
Thai Identity	6/12/50	26/4/51	143	1,276,600.290	818,837.140	2,095,437.430	12.91	257,841.00	744,918.50	1,002,759.50	132,976.770	2,905.00	1,332,672.70	0,000.00	2,335,432.20	111.45	97,599.000	46.58
Kampangpetch	11/12/50	2/4/51	114	121,820.070	801,757.830	923,577.900	12.20	279,954.50	0,000.00	279,954.50	68,997.590	4,373.00	694,348.90	0,000.00	974,303.40	105.49	38,000.000	41.14
Ruamphol Nakhonsawan	5/12/50	5/5/51	153	337,863.160	1,492,862.590	1,830,725.750	11.98	158,649.00	409,135.50	567,784.50	130,342.470	0,000.00	1,303,424.70	0,000.00	1,871,209.20	102.21	77,040.000	42.08
Nakornpetch	11/12/50	9/4/51	121	309,087.770	2,687,615.730	2,996,703.500	11.94	371,375.00	176,615.50	547,990.50	263,572.370	0,000.00	2,635,723.70	0,000.00	3,183,714.20	106.24	115,492.370	38.54
Kaset Thai	23/11/50	24/4/51	154	1,588,260.490	3,840,012.300	5,428,272.790	12.31	1,093,074.00	810,241.00	1,903,315.00	398,130.140	0,000.00	3,981,301.40	0,000.00	5,884,616.40	108.41	229,154.061	42.21
Thai Roong Runag	7/12/50	16/4/51	132	1,212,183.480	1,497,461.140	2,709,644.620	11.74	394,630.50	440,155.00	834,785.50	192,484.460	0,000.00	1,924,844.60	0,000.00	2,759,630.10	101.84	139,170.460	51.36
Phitsanulok	7/12/50	30/3/51	115	215,537.240	1,612,977.000	1,828,514.240	11.85	139,604.00	434,207.00	573,811.00	138,339.830	0,000.00	1,383,398.30	0,000.00	1,957,209.30	107.04	77,390.000	42.32
Total				5,213,829.385	13,232,644.480	18,446,473.860	12.16	2,902,834.50	3,015,272.50	5,918,107.00	1,373,159.317	7,278.00	13,738,871.17	0,000.00	19,656,978.17	106.56	797,006.591	43.21
Central Region																		
Singburi	23/11/50	15/4/51	145	259,074.900	1,300,322.620	1,559,397.520	11.89	162,261.50	450,941.00	613,202.50	103,689.610	0,000.00	1,036,896.10	0,000.00	1,650,098.60	105.82	69,010.000	44.25
Suphanburi Sugar Industry	28/11/50	8/4/51	133	74,724.460	361,212.720	435,937.180	11.49	5,017.00	12,206.00	17,223.00	40,834.410	0,000.00	408,344.10	0,000.00	425,567.10	97.62	19,803.270	45.43
U-Thong	17/1/51	7/4/51	82	267,786.900	560,370.420	828,157.320	12.11	242,155.00	74,475.00	316,630.00	56,465.170	0,000.00	564,651.70	0,000.00	881,281.70	106.41	31,067.000	37.51
Thai Mulit- Sugar Industry	17/12/50	13/4/51	119	710,279.410	495,517.450	1,205,796.860	11.06	0,000.00	901,635.00	901,635.00	24,394.550	0,000.00	243,945.50	0,000.00	1,145,580.50	95.01	56,655.310	46.99
Thai Sugar	17/12/50	5/4/51	111	499,750.100	622,716.780	1,122,466.880	11.24	282,337.00	470,985.00	753,322.00	32,932.300	0,000.00	329,323.00	0,000.00	1,082,645.00	96.45	49,386.440	44.00
Prachup Industry	17/12/50	5/4/51	111	597,733.000	392,846.670	990,579.670	11.20	224,065.00	343,646.00	567,711.00	40,596.420	0,000.00	405,964.20	0,000.00	973,675.20	98.29	45,741.000	46.18
Tamaka	17/12/50	9/4/51	115	746,708.840	668,844.460	1,415,553.300	11.11	373,420.00	669,898.00	1,043,318.00	32,623.762	0,000.00	326,237.62	0,000.00	1,369,555.62	96.75	67,546.509	47.72
New Krung Thai	20/12/50	4/4/51	107	413,528.000	495,872.950	909,400.950	10.97	142,806.50	456,171.00	598,977.50	31,366.140	0,000.00	313,661.40	0,000.00	912,638.90	100.36	39,944.440	43.92
Lin Sugar	28/11/50	16/4/51	141	482,506.480	1,680,880.450	2,163,386.930	11.80	159,536.00	733,147.00	892,683.00	138,170.970	0,000.00	1,381,709.70	0,035.42	2,274,428.12	105.13	97,115.000	44.89
Thai Kamchanaburi	17/12/50	5/4/51	111	708,437.660	455,551.670	1,163,989.330	11.33	712,212.00	240,620.50	952,832.50	20,970.790	0,000.00	209,707.90	0,000.00	1,162,540.40	99.88	52,321.110	44.95
Mitr Kasetr	17/12/50	7/4/51	113	708,112.410	301,581.250	1,009,693.660	11.17	573,969.50	0,000.00	573,969.50	42,750.270	0,000.00	427,502.70	0,000.00	1,001,472.20	99.19	43,665.200	43.25
Mitr Phol	28/11/50	22/4/51	147	1,013,752.010	2,526,688.070	3,540,440.080	11.80	262,402.60	1,300,504.46	1,562,907.06	208,053.475	0,000.00	2,080,534.75	2,371.90	3,645,813.71	102.98	170,802.935	48.24
Ban Pong	20/12/50	30/3/51	102	408,753.480	360,868.130	769,621.610	11.34	148,929.50	415,450.00	564,379.50	18,116.230	0,000.00	181,162.30	0,000.00	745,541.80	96.87	33,836.130	43.96
Rajburi	17/12/50	8/4/51	114	786,751.560	183,843.080	970,594.640	11.04	250,655.50	562,852.50	813,508.00	11,895.020	0,000.00	118,950.20	0,000.00	932,458.20	96.07	45,985.300	47.38
T.N. Sugar	15/12/50	7/4/51	115	323,518.690	849,370.750	1,172,889.440	12.33	289,146.78	201,096.00	490,242.78	70,060.600	0,000.00	700,606.00	2,312.50	1,193,161.28	101.73	62,111.680	52.96
Pranburi	27/12/50	4/4/51	100	389,332.000	107,904.980	497,236.980	11.27	295,187.50	174,754.50	469,942.00	4,117.955	0,000.00	41,179.55	0,000.00	511,121.55	102.79	21,830.930	43.90
Saraburi	1/12/50	12/4/51	134	1,282,969.290	1,341,726.990	2,624,696.280	11.85	344,219.00	435,196.00	779,415.00	199,335.530	0,000.00	1,993,355.30	0,000.00	2,772,770.30	105.64	146,958.382	55.99
Total				9,673,719.190	12,706,119.440	22,379,838.630	11.56	4,468,320.38	7,443,577.96	11,911,898.34	1,076,373.202	0,000.00	10,763,732.02	4,719.82	22,680,350.18	101.34	1,053,780.636	47.09
Eastern Region																		
New Kwang Soon Lee	10/12/50	3/4/51	116	169,394.800	531,276.940	700,671.740	10.95	134,210.00	230,016.50	364,226.50	34,224.260	0,000.00	342,242.60	0,000.00	706,469.10	100.83	35,249.260	50.31
Cholburi Sugar& Trading	10/12/50	25/3/51	107	235,869.120	587,226.620	823,095.740	10.66	420,745.00	52,500.00	473,245.00	30,521.310	0,000.00	305,213.10	0,000.00	778,458.10	94.58	37,730.910	45.84
Eastern Sugar	7/12/50		183	871,584.350	1,650,483.340	2,522,067.690	11.83	325,735.50	481,295.76	807,031.26	125,664.710	635,648.00	1,892,295.10	0,000.00	2,699,326.36	107.03	106,842.645	42.36
Rayong	10/12/50	10/4/51	123	188,557.130	406,726.240	595,283.370	11.26	454,331.50	0,000.00	454,331.50	8,595.290	0,000.00	85,952.90	0,000.00	540,284.40	90.76	36,001.580	60.48
Total				1,465,405.400	3,175,713.140	4,641,118.540	11.42	1,335,022.00	763,812.26	2,098,834.26	199,005.570	635,648.00	2,625,703.70	0,000.00	4,724,537.96	101.80	215,824.395	46.50
Total				1,142,381.580	2,162,108.420	3,304,490.000	11.19	924,697.50	735,040.50	1,659,738.00	136,558.320	262,000.00	1,627,583.20	0.00	3,287,321.20	99.48	157,264.540	47.59
Northeastern Region																		
Surin	11/12/50	6/4/51	118	855,452.560	813,450.120	1,668,902.680	12.92	259,486.00	478,251.46	737,737.46	114,595.000	6,600.00	1,152,550.00	0,000.00	1,890,287.46	113.27	63,221.032	37.88

REPORT ON CANE SUGAR PRODUCTION IN THAILAND

CROP YEAR 2007/2008

SEASON ENDING VERSION

Factory Name	Opening Date	Closing Date	Operated Day	Ton Cane Crashed (Tons)			c.c.s.	REFINED SUGAR			RAW SUGAR			Other Sugar	Grand Total	Sugar/ Ton Cane	Final Molasses	Final Molasses/ Ton Cane
				Cane	Burnt Cane	Total		White Sugar	Refined Sugar	Total	Bulk	Bag	Total	Ton	Ton		Ton	
E-Saan Sugar Industry	1/12/50	22/3/51	113	351,345.660	801,778.440	1,153,124.100	12.31	557,521.00	0,000.00	557,521.00	73,474.920	0,000.00	734,749.20	0,000.00	1,292,270.20	112.07	42,612.970	36.95
Mitr Kalasin	26/11/50		138	982,778.550	1,450,037.210	2,432,815.760	13.11	56,164.30	756,179.00	812,343.30	202,413.470	0,000.00	2,024,134.70	0,000.00	2,836,478.00	116.59	105,140.014	43.22
Wangkanai	2/3/51	23/3/51	22	25,192.610	9,853.790	35,046.400	14.72	0,000.00		0,000.00	1,707.370	0,000.00	17,073.70	0,000.00	17,073.70	48.72	1,530.000	43.66
Kaset Phol	1/12/50	1/4/51	123	293,731.640	1,217,395.150	1,511,126.790	12.44	410,937.00	0,000.00	410,937.00	106,300.430	168,512.50	1,231,516.80	0,000.00	1,642,453.80	108.69	55,791.880	36.92
Korach Industry	11/12/50	1/5/51	143	1,324,548.180	1,532,966.550	2,857,514.730	12.44	925,780.00	991,800.00	1,917,580.00	128,448.270	45,549.30	1,330,032.00	0,000.00	3,247,612.00	113.65	146,592.970	51.30
Mitr Phu Viang	26/11/50	22/4/51	149	2,378,309.010	619,024.640	2,997,333.650	12.47	973,753.93	0,000.00	973,753.93	212,143.370	292,725.00	2,414,158.70	0,000.00	3,387,912.63	113.03	127,751.340	42.62
Angvian	25/12/50	25/3/51	92	636,043.530	730,789.510	1,366,833.040	12.88	593,728.36	219,934.00	813,662.36	75,851.730	0,000.00	758,517.30	0,000.00	1,572,179.66	115.02	62,658.760	45.84
Kornburi	20/12/50	3/5/51	136	968,183.040	1,078,250.980	2,046,434.020	12.22	348,862.00	873,171.80	1,222,033.80	96,592.860	75,876.00	1,041,804.60	0,000.00	2,263,838.40	110.62	98,135.241	47.95
Rerm Udom	10/12/50	21/3/51	103	367,416.590	779,349.570	1,146,766.160	12.12	641,746.50	0,000.00	641,746.50	58,108.941	0,000.00	581,089.41	0,000.00	1,222,835.91	106.63	44,836.630	39.10
Kumpawapi	3/12/50	6/4/51	126	350,189.070	1,185,039.110	1,535,228.180	12.81	612,299.50	197,580.00	809,879.50	79,827.910	15,223.30	813,502.40	0,000.00	1,623,381.90	105.74	64,600.000	42.08
Khon Kaen	7/12/50	22/4/51	138	969,462.130	1,741,931.120	2,711,393.250	12.44	462,703.00	722,332.70	1,185,035.70	188,701.425	0,000.00	1,887,014.25	0,000.00	3,072,049.95	113.30	112,249.497	41.40
Saharuang	3/12/50	12/3/51	101	356,284.210	713,020.980	1,069,305.190	12.93	772,550.00	0,000.00	772,550.00	44,051.680	0,000.00	440,516.80	0,000.00	1,213,066.80	113.44	49,290.120	46.10
Buriram	1/12/50	6/5/51	158	589,124.420	865,509.560	1,454,633.980	12.35	181,882.50	0,000.00	181,882.50	53,329.600	906,135.55	1,439,431.55	0,000.00	1,621,314.05	111.46	60,057.470	41.29
United Farmer & Industry	1/12/50	13/4/51	134	2,207,308.880	704,771.430	2,912,080.310	12.65	328,255.50	1,193,144.27	1,521,399.77	165,584.380	0,000.00	1,655,843.80	0,000.00	3,177,243.57	109.11	139,387.960	47.87
Erawan Sugar	7/12/50	31/3/51	116	324,109.320	618,264.240	942,373.560	12.24	0,000.00	0,000.00	0,000.00	102,358.067	0,000.00	1,023,580.67	0,000.00	1,023,580.67	108.62	37,876.178	40.19
Total				12,979,479.400	14,861,432.400	27,840,911.800	12.57	7,125,669.59	5,432,393.23	12,558,062.82	1,703,489.423	1,510,621.65	18,545,515.88	0,000.00	31,103,578.70	111.72	1,211,732.062	43.52
Grand Total				29,332,433.380	43,975,909.460	73,308,342.830	12.09	15,831,846.47	16,655,055.95	32,486,902.42	4,352,027.512	2,153,547.65	45,673,822.77	4,719.82	78,165,445.01	106.63	3,278,343.684	44.72

REPORT ON CANE SUGAR PRODUCTION IN THAILAND

CROP YEAR 2006/2007

SEASON ENDING VERSION

Factory Name	Opening Date	Closing Date	Operated Day	Ton Cane Crashed (Tons)			C.C.S.	REFINED SUGAR			RAW SUGAR			Other Sugar	Grand Total	Sugar/ Ton Cane	Final Molasses	Final Molasses/ Ton Cane
				Cane	Burnt Cane	Total		White Sugar	Refined Sugar	Total	Bulk	Bag	Total	Ton	Ton		Ton	
North Region																		
Mae Wang Sugar Industry	25/12/49	15/3/50	81	50,235.379	156,828.157	207,063.536	12.48	160,085.00	0.00	160,085.00	6,324.341	0.00	63,243.41	0.00	223,328.41	107.86	8,220.000	39.70
Uttaradit Sugar Industry	15/12/49	15/4/50	122	72,731.810	255,892.230	328,624.040	13.03	175,000.00	0.00	175,000.00	20,628.930	0.00	206,289.30	0.00	381,289.30	116.03	11,602.300	35.31
Thai Identity	15/12/49	5/4/50	112	1,014,884.950	731,359.210	1,746,244.160	13.03	290,784.00	572,044.50	862,828.50	118,397.600	0.00	1,183,976.00	0.00	2,046,804.50	117.21	68,291.345	39.11
Kampangpetch	16/12/49	16/4/50	122	124,273.830	655,498.540	779,772.370	12.42	379,161.00	0.00	379,161.00	33,907.750	122,511.00	461,588.50	0.00	840,749.50	107.82	30,823.000	39.53
Ruamphol Nakhonsawan	15/12/49	7/5/50	144	325,984.970	1,324,263.550	1,650,248.520	11.95	545,339.50	0.00	545,339.50	118,852.750	14,626.70	1,203,154.20	0.00	1,748,493.70	105.95	75,651.000	45.84
Nakornpetch	18/12/49	30/3/50	103	280,830.680	2,224,807.600	2,505,638.280	12.23	369,595.50	543,046.50	912,642.00	175,904.430	0.00	1,759,044.30	0.00	2,671,686.30	106.63	107,248.740	42.80
Kaset Thai	10/12/49	16/5/50	158	1,321,778.070	4,227,559.590	5,549,337.660	12.36	1,297,473.76	710,306.50	2,007,780.26	369,830.610	426,963.90	4,125,270.00	0.00	6,133,050.26	110.52	256,875.779	46.29
Thai Roong Ruang	11/12/49	12/4/50	123	1,063,882.980	1,633,032.140	2,696,915.120	12.15	450,652.00	746,726.00	1,197,378.00	175,654.740	0.00	1,756,547.40	0.00	2,953,925.40	109.53	129,383.960	47.97
Phitsanulok	15/12/49	27/3/50	103	195,464.620	1,405,273.260	1,600,737.880	12.31	129,520.00	568,282.00	697,802.00	106,037.480	0.00	1,060,374.80	0.00	1,758,176.80	109.84	72,179.000	45.09
Total				4,450,067.289	12,614,514.277	17,064,581.566	12.35	3,797,610.76	3,140,405.50	6,938,016.26	1,125,538.631	564,101.60	11,819,487.91	0.00	18,757,504.17	109.92	760,275.124	44.55
Central Region																		
Singburi	10/12/49	27/4/50	139	335,987.670	1,216,602.110	1,552,589.780	11.91	117,006.00	417,476.00	534,482.00	111,544.396	0.00	1,115,443.96	0.00	1,649,925.96	106.27	73,901.330	47.60
Suphanburi Sugar Industry	15/12/49	15/4/50	122	108,710.060	303,552.970	412,263.030	11.49	21,129.00	138,390.00	159,519.00	20,168.790	0.00	201,687.90	0.00	361,206.90	87.62	22,064.070	53.52
U-Thong	15/12/49	23/3/50	99	333,780.180	427,621.940	761,402.120	10.87	291,913.00	85,952.00	377,865.00	33,025.500	0.00	330,255.00	0.00	708,120.00	93.00	39,265.000	51.57
Thai Multi- Sugar Industry	20/12/49	9/4/50	111	749,290.080	356,194.150	1,105,484.230	10.65	212,935.00	566,871.50	779,806.50	30,741.780	0.00	307,417.80	0.00	1,087,224.30	98.35	57,972.000	52.44
Thai Sugar	20/12/49	6/4/50	108	483,864.280	549,777.910	1,033,642.190	10.73	267,533.00	336,540.00	604,073.00	37,498.400	0.00	374,984.00	0.00	979,057.00	94.72	49,494.650	47.88
Prachup Industry	20/12/49	6/5/50	138	631,573.940	368,475.400	1,000,049.340	11.05	238,222.50	653,155.50	891,378.00	5,334.110	0.00	53,341.10	0.00	944,719.10	94.47	50,428.520	50.43
Tamaka	20/12/49	12/5/50	144	799,858.000	640,000.530	1,439,858.530	10.77	621,143.00	577,535.00	1,198,678.00	17,669.400	0.00	176,694.00	0.00	1,375,372.00	95.52	71,172.070	49.43
New Krung Thai	20/12/49	10/5/50	142	491,421.260	391,491.850	882,913.110	10.78	271,416.50	394,478.50	665,895.00	17,440.790	0.00	174,407.90	0.00	840,302.90	95.17	41,462.620	46.96
Lin Sugar	15/12/49	14/4/50	121	476,190.540	1,369,419.860	1,845,610.400	12.26	101,556.00	788,267.00	889,823.00	117,867.770	0.00	1,178,677.70	36.04	2,068,536.74	112.08	83,119.000	45.04
Thai Kamchanaburi	20/12/49	23/4/50	125	748,670.430	371,015.480	1,119,685.910	11.28	829,881.00	180,000.50	1,009,881.50	6,856.390	0.00	68,563.90	0.00	1,078,445.40	96.32	52,515.910	46.90
Mitr Kasetr	20/12/49	3/4/50	105	690,685.970	261,567.340	952,253.310	10.78	604,494.00	0.00	604,494.00	30,233.710	0.00	302,337.10	0.00	906,831.10	95.23	42,728.500	44.87
Mitr Phol	15/12/49	23/4/50	130	1,150,365.960	2,101,627.710	3,251,993.670	11.91	231,454.60	772,172.50	1,003,627.10	242,744.810	0.00	2,427,448.10	2,515.40	3,433,590.60	105.58	167,437.000	51.49
Ban Pong	20/12/49	8/4/50	110	517,658.400	242,393.940	760,052.340	10.95	212,628.00	490,997.50	703,625.50	0.000	0.00	0.00	0.00	703,625.50	92.58	37,887.010	49.85
Rajburi	20/12/49	31/3/50	102	787,526.610	125,496.790	913,023.400	10.93	209,707.47	287,536.00	497,243.47	38,953.000	0.00	389,530.00	0.00	886,773.47	97.12	46,870.700	51.34
T.N. Sugar	10/12/49	17/3/50	98	320,951.360	604,020.040	924,971.400	11.72	252,951.50	37,676.50	290,628.00	66,050.640	4,347.20	664,853.60	2,688.90	958,170.50	103.59	49,518.430	53.54
Pranburi	15/12/49	16/5/50	153	463,997.520	66,741.970	530,739.490	11.69	253,879.00	240,745.00	494,624.00	3,595.995	0.00	35,959.95	0.00	530,583.95	99.97	26,420.105	49.78
Saraburi	10/12/49	26/4/50	138	1,296,616.770	1,434,991.520	2,731,608.290	11.75	44,697.00	1,042,226.00	1,086,923.00	183,857.340	0.00	1,838,573.40	0.00	2,925,496.40	107.10	134,465.281	49.23
Total				10,387,149.030	10,830,991.510	21,218,140.540	11.41	4,782,546.57	7,010,019.50	11,792,566.07	963,582.821	4,347.20	9,640,175.41	5,240.34	21,437,981.82	101.04	1,046,722.196	49.33
Eastern Region																		
New Kwang Soon Lee	11/12/49	18/3/50	98	131,403.900	422,081.070	553,484.970	10.46	106,586.00	197,710.00	304,296.00	22,435.190	0.00	224,351.90	0.00	528,647.90	95.51	26,434.810	47.76
ไทยรุ่	11/12/49	10/3/50	90	58,389.250	177,682.220	236,071.470	10.42	97,085.00	0.00	97,085.00	10,305.660	0.00	103,056.60	0.00	200,141.60	84.78	10,002.170	42.37
Cholburi Sugar& Trading	12/12/49	11/3/50	90	160,472.900	362,311.390	522,784.290	10.54	273,239.00	88,524.00	361,763.00	12,089.320	0.00	120,893.20	0.00	482,656.20	92.32	24,039.540	45.98
Eastern Sugar	7/12/49	26/3/50	110	662,632.730	961,292.540	1,623,925.270	11.87	188,189.50	397,367.00	585,556.50	89,847.650	262,000.00	1,160,476.50	0.00	1,746,033.00	107.52	76,890.000	47.35
Rayong	11/12/49	21/3/50	101	129,482.800	238,741.200	368,224.000	10.71	259,598.00	51,439.50	311,037.50	1,880.500	0.00	18,805.00	0.00	329,842.50	89.58	19,898.020	54.04
Total				1,142,381.580	2,162,108.420	3,304,490.000	11.19	924,697.50	735,040.50	1,659,738.00	136,558.320	262,000.00	1,627,583.20	0.00	3,287,321.20	99.48	157,264.540	47.59
Northeastern Region																		
Surin	15/12/49	21/4/50	128	427,236.640	305,640.520	732,877.160	12.32	243,935.00	0.00	243,935.00	45,721.610	40,000.00	497,216.10	0.00	741,151.10	101.13	33,523.580	45.74

REPORT ON CANE SUGAR PRODUCTION IN THAILAND

CROP YEAR 2006/2007

SEASON ENDING VERSION

Factory Name	Opening Date	Closing Date	Operated Day	Ton Cane Crashed (Tons)			c.c.s.	REFINED SUGAR			RAW SUGAR			Other Sugar	Grand Total	Sugar/ Ton Cane	Final Molasses	Final Molasses/ Ton Cane
				Cane	Burnt Cane	Total		White Sugar	Refined Sugar	Total	Bulk	Bag	Total	Ton	Ton		Ton	
E-Saan Sugar Industry	1/12/49	23/5/50	174	270,238.610	824,800.120	1,095,038.730	12.15	515,134.50	0.00	515,134.50	59,764.120	0.00	597,641.20	0.00	1,112,775.70	101.62	47,295.240	43.19
Mitr Kalasin	1/12/49	11/3/50	101	649,207.320	1,138,846.760	1,788,054.080	12.26	233,432.00	417,026.00	650,458.00	136,419.990	0.00	1,364,199.90	0.00	2,014,657.90	112.67	74,217.590	41.51
Kaset Phol	1/12/49	21/3/50	111	201,076.630	1,203,088.210	1,404,164.840	12.02	450,234.50	0.00	450,234.50	80,067.760	235,050.00	1,035,727.60	0.00	1,485,962.10	105.83	56,008.000	39.89
Korach Industry	7/12/49	29/3/50	113	959,435.300	1,103,212.060	2,062,647.360	11.89	527,530.86	792,325.00	1,319,855.86	92,099.760	0.00	920,997.60	0.00	2,240,853.46	108.64	106,526.140	51.65
Mitr Phu Viang	1/12/49	4/4/50	125	2,250,707.330	391,069.060	2,641,776.390	12.05	833,731.50	0.00	833,731.50	188,037.210	124,560.00	2,004,932.10	88,610.64	2,927,274.24	110.81	116,635.360	44.15
Angvian	15/12/49	11/3/50	87	692,723.280	372,788.760	1,065,512.040	11.91	341,977.00	89,611.00	431,588.00	65,530.540	0.00	655,305.40	36,888.00	1,123,781.40	105.47	57,332.260	53.81
Komburi	19/12/49	31/3/50	103	698,823.180	917,317.480	1,616,140.660	12.16	282,940.10	616,200.50	899,140.60	86,376.020	11,108.50	874,868.70	0.00	1,774,009.30	109.77	76,416.480	47.28
Rerm Udom	8/12/49	27/3/50	110	553,591.750	832,584.590	1,386,176.340	11.85	489,210.00	120,000.00	609,210.00	72,763.744	0.00	727,637.44	0.00	1,336,847.44	96.44	60,258.770	43.47
Kumpawapi	1/12/49	16/5/50	167	181,428.260	1,201,436.970	1,382,865.230	12.33	542,141.50	365,044.50	907,186.00	49,707.450	0.00	497,074.50	19,340.55	1,423,601.05	102.95	63,485.000	45.91
Khon Kaen	1/12/49	30/3/50	120	685,181.280	1,703,924.080	2,389,105.360	12.48	499,501.50	536,027.50	1,035,529.00	155,026.690	0.00	1,550,266.90	0.00	2,585,795.90	108.23	106,660.170	44.64
Saharuang	6/12/49	29/3/50	114	229,270.130	574,636.600	803,906.730	12.34	650,838.50	145,040.00	795,878.50	6,574.400	0.00	65,744.00	0.00	861,622.50	107.18	40,437.780	50.30
Buriram	9/12/49	30/3/50	112	394,332.410	629,926.630	1,024,259.040	12.07	152,748.00	0.00	152,748.00	50,591.250	491,007.00	996,919.50	0.00	1,149,667.50	112.24	48,079.650	46.94
United Farmer & Industry	6/12/49	10/4/1950	126	2,289,049.960	529,021.550	2,818,071.510	12.18	365,776.40	960,327.75	1,326,104.15	161,090.700	0.00	1,610,907.00	0.00	2,937,011.15	104.22	148,053.020	52.54
Total				10,482,302.080	11,728,293.390	22,210,595.470	12.14	6,129,131.36	4,041,602.25	10,170,733.61	1,249,771.244	901,725.50	13,399,437.94	144,839.19	23,715,010.74	106.77	1,034,929.040	46.60
Grand Total				26,461,899.979	37,335,907.597	63,797,807.576	11.91	15,633,986.19	14,927,067.75	30,561,053.94	3,475,451.016	1,732,174.30	36,486,684.46	150,079.53	67,197,817.93	105.33	2,999,190.900	47.01

ศูนย์บริหารการผลิตฯ

ฝ่ายวิชาการและแผนงาน

25 พฤษภาคม 2550

REPORT ON CANE SUGAR PRODUCTION IN THAILAND

CROP YEAR 2005/2006

SEASON ENDING VERSION

Factory Name	Opening Date	Closing Date	Operated Day	Ton Cane Crashed (Tons)			C.C.S.	REFINED SUGAR			RAW SUGAR			Other Sugar Ton	Grand Total Ton	Sugar/ Ton Cane	Final Molasses Ton	Final Molasses / Ton
				Cane	Burnt Cane	Total		White Sugar	Refined Sugar	Total	Bulk	Bag	Total					
North Region																		
Mae Wang Sugar Industry	5/1/49	8/3/49	63	57,752.760	94,564.300	152,317.060	12.84	130,015.00	0.00	130,015.00	3,009.450	0.00	30,094.50	0.00	160,109.50	105.12	7,132.000	46.82
Uttaradit Sugar Industry	20/12/48	31/3/49	102	85,825.840	178,703.170	264,529.010	12.65	190,500.00	0.00	190,500.00	10,642.330	0.00	106,423.30	0.00	296,923.30	112.25	9,962.400	37.66
Thai Identity	22/12/48	30/3/49	99	956,699.950	559,940.800	1,516,640.750	12.84	330,632.50	529,579.50	860,212.00	89,438.630	0.00	894,386.30	0.00	1,754,598.30	115.69	64,059.879	42.24
Kampangpetch	20/12/48	2/4/49	104	76,736.770	616,947.510	693,684.280	10.79	354,742.00	0.00	354,742.00	34,914.470	0.00	349,144.70	0.00	703,886.70	101.47	27,750.000	40.00
Ruamphol Nakhonsawan	25/12/48	17/4/49	114	242,379.380	920,288.330	1,162,667.710	11.77	423,317.00	0.00	423,317.00	79,384.620	0.00	793,846.20	0.00	1,217,163.20	104.69	50,366.000	43.32
Nakornpetch	20/12/48	5/4/49	107	188,911.880	1,953,607.410	2,142,519.290	11.78	866,049.00	220,189.00	1,086,238.00	113,340.230	0.00	1,133,402.30	0.00	2,219,640.30	103.60	86,257.770	40.26
Kaset Thai	20/12/48	3/4/49	105	1,262,446.590	2,519,474.680	3,781,921.270	12.13	835,810.90	515,709.00	1,351,519.90	274,577.810	0.00	2,745,778.10	0.00	4,097,298.00	108.34	167,628.475	44.32
Thai Roong Runag	20/12/48	12/3/49	83	723,427.330	455,961.210	1,179,388.540	11.67	401,963.00	245,592.00	647,555.00	60,503.220	0.00	605,032.20	0.00	1,252,587.20	106.21	56,190.410	47.64
Phitsanulok	20/12/48	17/3/49	88	149,572.170	1,023,840.130	1,173,412.300	12.01	173,590.50	318,608.50	492,199.00	75,305.620	0.00	753,056.20	0.00	1,245,255.20	106.12	50,836.000	43.32
Total				3,743,752.670	8,323,327.540	12,067,080.210	12.01	3,706,619.90	1,829,678.00	5,536,297.90	741,116.38	0.00	7,411,163.80	0.00	12,947,461.70	107.30	520,182.934	43.11
Central Region																		
Singburi	20/12/48	30/3/49	101	307,248.270	714,657.150	1,021,905.420	11.20	115,441.00	250,677.50	366,118.50	66,738.284	0.00	667,382.84	0.00	1,033,501.34	101.13	45,055.310	44.09
Suphanburi Sugar Industry	25/12/48	18/3/49	84	85,832.940	200,905.680	286,738.620	10.96	0.00	106,495.00	106,495.00	15,050.520	0.00	150,505.20	0.00	257,000.20	89.63	14,194.290	49.50
U-Thong	26/12/48	7/4/49	103	675,162.740	544,868.440	1,220,031.180	10.96	403,293.06	66,898.50	470,191.56	71,311.800	0.00	713,118.00	0.00	1,183,309.56	96.99	55,115.000	45.18
Thai Multi-Sugar Industry	26/12/48	3/4/49	99	501,219.530	254,056.540	755,276.070	10.27	210,956.00	235,773.00	446,729.00	27,015.640	0.00	270,156.40	0.00	716,885.40	94.92	35,446.000	46.93
Thai Sugar	26/12/48	31/3/49	96	280,352.970	412,727.590	693,080.560	10.77	404,236.00	60,325.00	464,561.00	20,320.300	0.00	203,203.00	0.00	667,764.00	96.35	30,870.260	44.54
Prachup Industry	26/12/48	2/4/49	98	506,095.240	169,428.910	675,524.150	10.57	284,065.00	190,548.00	474,613.00	17,741.910	100.00	177,519.10	0.00	652,132.10	96.54	31,070.640	45.99
Tamaka	28/12/48	17/4/49	111	696,720.810	432,048.220	1,128,769.030	10.63	550,728.00	385,253.00	935,981.00	13,852.830	0.00	138,528.30	0.00	1,074,509.30	95.19	52,497.430	46.51
New Krung Thai	26/12/48	11/4/49	107	445,796.470	255,198.700	700,995.170	10.70	335,501.00	287,395.00	622,896.00	4,086.900	0.00	40,869.00	0.00	663,765.00	94.69	32,373.370	46.18
Lin Sugar	25/12/48	1/4/49	98	418,619.980	801,603.540	1,220,223.520	11.23	219,894.00	392,696.50	612,590.50	64,329.290	0.00	643,292.90	0.00	1,255,883.40	102.92	51,081.000	41.86
Thai Kamchanaburi	26/12/48	11/4/49	107	716,254.120	245,478.590	961,732.710	10.91	845,029.00	0.00	845,029.00	6,962.860	0.00	69,628.60	0.00	914,657.60	95.11	43,984.520	45.73
Mitr Kasetr	26/12/48	11/4/49	107	604,162.970	176,801.030	780,964.000	10.68	343,936.50	0.00	343,936.50	40,588.790	0.00	405,887.90	0.00	749,824.40	96.01	33,707.900	43.16
Mitr Phol	25/12/48	7/4/49	104	939,197.510	1,471,033.040	2,410,230.550	11.10	217,026.50	625,242.00	842,268.50	156,114.550	0.00	1,561,145.50	2,230.00	2,405,644.00	99.81	109,832.740	45.57
Ban Pong	26/12/48	22/3/49	87	413,603.960	89,115.150	502,719.110	10.79	121,844.00	131,269.00	253,113.00	22,276.290	0.00	222,762.90	0.00	475,875.90	94.66	23,601.980	46.95
Rajburi	3/1/49	10/4/49	98	673,923.260	112,906.670	786,829.930	10.65	528,472.46	28,503.50	556,975.96	21,510.890	0.00	215,108.90	0.00	772,084.86	98.13	36,736.430	46.69
T.N. Sugar	20/12/48	18/3/49	89	613,741.560	430,249.640	1,043,991.200	11.47	398,803.43	11,632.00	410,435.43	63,906.180	0.00	639,061.80	3,179.40	1,052,676.63	100.83	54,746.160	52.44
Pranburi	26/12/48	13/4/49	109	482,523.690	43,493.380	526,017.070	10.69	178,361.03	229,663.00	408,024.03	10,309.345	0.00	103,093.45	0.00	511,117.48	97.17	24,500.435	46.58
Saraburi	20/12/48	21/3/49	92	995,503.790	326,546.810	1,322,050.600	11.05	312,286.00	359,929.00	672,215.00	63,834.300	0.00	638,343.00	0.00	1,310,558.00	99.13	70,054.850	52.99
Total				9,787,143.760	7,062,922.520	16,850,066.280	10.91	5,751,768.98	3,428,360.50	9,180,129.48	724,329.749	100.00	7,243,397.49	5,409.40	16,428,936.37	97.50	786,430.315	46.67
Eastern Region																		
New Kwang Soon Lee	26/12/48	29/3/49	94	125,960.760	335,578.690	461,539.450	10.00	115,569.84	196,317.00	311,886.84	12,788.230	0.00	127,882.30	0.00	439,769.14	95.28	20,278.780	43.94
Cholburi Sugar	26/12/48	29/3/49	94	73,719.590	162,065.810	235,785.400	9.79	61,485.00	0.00	61,485.00	12,721.580	0.00	127,215.80	0.00	188,700.80	80.03	10,777.010	45.71
Cholburi Sugar & Trading	27/12/48	22/3/49	86	148,156.650	271,713.560	419,870.210	10.20	267,403.00	0.00	267,403.00	9,901.090	0.00	99,010.90	0.00	366,413.90	87.27	18,353.700	43.71
Eastern Sugar	27/12/48	17/3/49	81	403,628.160	588,991.290	992,619.450	11.59	356,343.50	240,507.00	596,850.50	43,277.530	0.00	432,775.30	0.00	1,029,625.80	103.73	45,306.000	45.64
Rayong	26/12/48	2/4/49	98	183,562.300	199,691.860	383,254.160	10.36	300,030.00	0.00	300,030.00	1,826.370	0.00	18,263.70	0.00	318,293.70	83.05	19,923.830	51.99
Total				935,027.460	1,558,041.210	2,493,068.670	10.70	1,100,831.340	436,824.000	1,537,655.340	80,514.800	0.00	805,148.000	0.00	2,342,803.340	93.97	114,639.320	45.98
Northeastern Region																		
E-Saan Sugar Industry	10/12/48	14/3/49	95	265,043.330	646,859.470	911,902.800	12.53	279,910.34	0.00	279,910.34	76,161.690	0.00	761,616.90	0.00	1,041,527.24	114.21	35,155.500	38.55
Mitr Kalasin	10/12/48	6/3/49	87	584,224.550	721,235.520	1,305,460.070	12.44	211,164.50	330,431.00	541,595.50	99,390.920	0.00	993,909.20	1,000.00	1,536,504.70	117.70	50,768.490	38.89
Kaset Phol	10/12/48	11/3/49	92	277,380.290	753,937.250	1,031,317.540	12.43	496,772.50	0.00	496,772.50	52,182.650	110,067.00	631,893.50	0.00	1,128,666.00	109.44	41,753.880	40.49
Korach Industry	17/12/48	11/4/49	116	713,574.570	777,827.000	1,491,401.570	11.80	1,314,455.00	62,300.00	1,376,755.00	15,287.000	60,000.00	212,870.00	0.00	1,589,625.00	106.59	77,721.040	52.11
Mitr Phu Viang	11/12/48	15/3/49	95	1,517,525.870	152,227.350	1,669,753.220	12.24	421,536.00	0.00	421,536.00	115,089.090	255,276.00	1,406,166.90	43,278.90	1,870,981.80	112.05	71,153.800	42.61
Angvian	15/12/48	25/3/49	101	424,135.670	287,540.680	711,676.350	12.09	273,374.00	2,601.00	275,975.00	19,268.700	0.00	192,687.00	253,160.50	721,822.50	101.43	37,324.910	52.45
N.Y. Sugar	16/12/48	28/3/49	103	458,554.120	478,689.400	937,243.520	11.23	427,308.50	389,745.50	817,054.00	10,860.545	0.00	108,605.45	0.00	925,659.45	98.76	46,460.835	49.57
Rerm Udom	16/12/48	4/4/49	110	414,267.470	621,769.020	1,036,036.490	12.39	821,074.00	0.00	821,074.00	22,190.924	0.00	221,909.24	0.00	1,042,983.24	100.67	47,127.750	45.49
Kumphawapi	10/12/48	9/3/49	90	270,420.510	859,506.760	1,129,927.270	12.96	262,138.19	231,836.00	493,974.19	73,421.150	1,273.90	735,485.40	23,330.45	1,252,790.04	110.87	47,135.000	41.72
Khon Kaen	10/12/48	14/3/49	94	389,118.060	1,331,869.850	1,720,987.910	12.54	358,325.46	462,598.50	820,923.96	110,302.120	0.00	1,103,021.20	0.00	1,923,945.16	111.79	72,434.160	42.09
Saharuang	10/12/48	22/3/49	103	245,326.050	480,609.970	725,936.020	12.49	758,534.00	0.00	758,534.00	6,835.200	0.00	68,352.00	0.00	826,886.00	113.91	33,952.170	46.77
Buriram	15/12/48	5/4/49	112	292,135.100	363,479.510	655,614.610	12.10	325,153.50	0.00	325,153.50	18,828.170	195,623.65	383,905.35	0.00	709,058.85	108.15	32,281.460	49.24
United Farmer & Industry	10/12/48	19/3/49	98	1,751,266.730	200,982.950	1,952,249.680	11.81	329,980.75	717,545.75	1,047,526.50	101,316.470	0.00	1,013,164.70	0.00	2,060,691.20	105.55	95,112.450	48.72
Total				7,602,972.320	7,676,534.730	15,279,507.050	12.22	6,279,726.74	2,197,057.75	8,476,784.49	721,134.63	622,240.55	7,833,586.84	320,769.85	16,631,141.18	108.85	688381.445	45.05
Grand Total				22,068,896.210	24,620,826.000	46,689,722.210	11.61	16,838,946.96	7,891,920.25	24,730,867.21	2,267,095.558	622,340.55	23,293,296.13	326,179.25	48,350,342.59	103.56	2,109,634.014	45.18

REPORT ON CANE SUGAR PRODUCTION IN THAILAND

CROP YEAR 2004/2005

SEASON ENDING VERSION

Factory Name	Opening Date	Closing Date	Operated Date	Ton Cane Crashed (Tons)			C.C.S.	REFINED SUGAR			RAW SUGAR			Other Sugar Ton	Grand Total Ton	Sugar/ Ton Cane	Final Molasses Ton	Final Molasses / Ton
				Cane	Burnt Cane	Total		White Sugar	Refined Sugar	Total	Bulk	Bag	Total					
North Region																		
Mae Wang Sugar Industry	8/12/47	*4/2/48	59	82315.036	32356.964	114672	12.10	94640	0	94640	2156.232	0	21562.32	0	116202.32	101.33	5084	44.34
Uttaradit Sugar Industry	10/12/47	*6/3/48	87	60751.97	149413.53	210165.5	12.72	165000	0	165000	6660.95	0	66609.5	0	231609.5	110.20	8931.4	42.50
Thai Identity	10/12/47	21/3/48	102	802336.49	540094.01	1342430.5	12.83	253688	541674	795362	68738.35	74916.5	762300	0	1557662	116.03	54875.001	40.88
Kampangpetch	13/12/47	*11/3/48	89	124878.66	562513.41	687392.07	11.60	265734	0	265734	48459.05	0	484590.5	0	750324.5	109.16	28580.2	41.58
Ruamphol Nakhonsawan	10/12/47	*12/3/48	93	278624.24	879030.63	1157654.87	12.46	284644.5	0	284644.5	101616.56	0	1016165.6	0	1300810.1	112.37	47126	40.71
Nakornpetch	13/12/47	*13/3/48	91	267431.01	1733828.12	2001259.13	12.52	562661.5	190782.5	753444	148242.62	0	1482426.2	0	2235870.2	111.72	75247.62	37.60
Kaset Thai	7/12/47	21/3/48	105	1564032.25	2044303.46	3608335.71	12.34	720405	536116.5	1256521.5	271300.7	1050	2714057	0	3970578.5	110.04	169009.071	46.84
Thai Roong Runag	8/12/47	*6/3/48	89	1022632.65	401444.25	1424076.9	11.78	638299	80045	718344	83860.71	0	838607.1	0	1556951.1	109.33	70289.68	49.36
Phitsanulok	13/12/47	21/3/48	99	154216.44	998816.42	1153032.86	12.42	599562	55040	654602	61786.19	0	617861.9	0	1272463.9	110.36	48673	42.21
Total				4372832.236	7352676.584	11725508.82	12.34	3599016	1403658	5002674	793113.362	86345.5	8017479.12	0	13020153.12	111.04	508513.472	43.37
Central Region																		
Singburi	7/12/47	*13/3/48	97	309063.91	592942.35	902006.26	11.77	82085	154538	236623	70225.91	0	702259.1	0	938882.1	104.09	45236.9	50.15
Suphanburi Sugar Industry	13/12/47	*28/2/48	78	73576.83	181419.92	254996.75	11.41	0	102655	102655	13885.06	0	138850.6	0	241505.6	94.71	14315.52	56.14
U-Thong	16/12/47	*13/3/48	88	456642.96	146125.82	602768.78	10.90	351818	45275	397093	19529.83	0	195298.3	0	592391.3	98.28	29865	49.55
Thai Multi-Sugar Industry	16/12/47	*10/3/48	85	310094.29	318041.25	628135.54	10.90	389428	18580	408008	18771.2	0	187712	0	595720	94.84	28288.99	45.04
Thai Sugar	20/12/47	*13/3/48	84	366869.63	175694.08	542563.71	10.98	183955.5	104963.5	288919	19472.04	0	194720.4	0	483639.4	89.14	32778	60.41
Prachup Industry	16/12/47	*13/3/48	88	410123.45	167157.06	577280.51	11.12	239917	260458	500375	6298.62	0	62986.2	0	563361.2	97.59	28190.93	48.83
Tamaka	16/12/47	21/3/48	96	645926.79	282918.71	928845.5	10.77	563977	265768	829745	4440.24	0	44402.4	0	874147.4	94.11	44700.15	48.12
New Krung Thai	16/12/47	*14/3/48	89	357008.5	200172.94	557181.44	10.94	234770.5	171291.5	406062	10652.28	0	106522.8	0	512584.8	92.00	27089.67	48.62
Lin Sugar	13/12/47	*12/3/48	90	363168.79	847663.29	1210832.08	12.14	457060	131021	588081	73670.48	0	736704.8	0	1324785.8	109.41	55009	45.43
Thai Kamchanaburi	16/12/47	*18/3/48	93	654487.78	170866.92	825354.7	11.19	743575.5	0	743575.5	6462.89	0	64628.9	0	808204.4	97.92	35992.89	43.61
Mitr Kasetr	16/12/47	*17/3/48	92	576104.21	127993.67	704097.88	11.18	381337.5	0	381337.5	31458.33	0	314583.3	0	695920.8	98.84	31829	45.21
Mitr Phol	13/12/47	21/3/48	99	749583.72	1345291.13	2094874.85	11.78	206087.3	542353	748440.3	142252.62	0	1422526.2	710	2171676.5	103.67	107745.75	51.43
Ban Pong	16/12/47	*13/3/48	88	450375.43	71481.58	521857.01	11.38	192643	130537	323180	19258.81	0	192588.1	0	515768.1	98.83	25158.98	48.21
Rajburi	16/12/47	21/3/48	96	580678.87	97097.69	677776.56	11.46	438388	122210	560598	11514.22	0	115142.2	0	675740.2	99.70	33918.3	50.04
T.N. Sugar	7/12/47	21/3/48	105	877327.41	408454.35	1285781.76	12.03	354908.003	92868	447776.003	82997.13	0	829971.3	0	1277747.303	99.38	75904.17	59.03
Pranburi	13/12/47	21/3/48	99	431749.1	31964.92	463714.02	11.88	251476	132024	383500	9510.62	0	95106.2	0	478606.2	103.21	22458.305	48.43
Saraburi	7/12/47	*16/3/48	100	1225654.54	384308.4	1609962.94	12.04	594030	210591	804621	91282.39	0	912823.9	0	1717444.9	106.68	90235.08	56.05
Total				9389771.23	5975872.39	15365643.62	11.51	6136495.303	2558838.5	8695333.803	669200.17	0	6692001.7	1280.5	15388616	100.15	784446.635	51.05
Eastern Region																		
New Kwang Soon Lee	8/12/47	21/3/48	104	216419.41	313280.21	529699.62	10.72	217181	115641	332822	18990.01	0	189900.1	0	522722.1	98.68	26775.62	50.55
Cholburi Sugar	8/12/47	*7/3/48	90	116491.04	185484.86	301975.9	10.66	73231	0	73231	18630.74	0	186307.4	0	259538.4	85.95	14776.39	48.93
Cholburi Sugar & Trading	14/12/47	*1/3/48	78	212432.47	305867.58	518300.05	10.58	267354	0	267354	22129.42	0	221294.2	0	488648.2	94.28	25223.09	48.67
Eastern Sugar	15/12/47	*1/3/48	77	541290.48	465937.15	1007227.63	12.34	409610	159416	569026	50889.48	4418	513312.8	0	1082338.8	107.46	54040	53.65
Rayong	16/12/47	*13/3/48	88	101355.28	88089.18	189444.46	11.16	111398	0	111398	4468.42	0	44684.2	0	156082.2	82.39	10839.01	57.21
Total				1187988.68	1358658.98	2546647.66	11.36	1078774	275057	1353831	115108.07	4418	1155498.7	0	2509329.7	98.53	131654.11	51.70
Northeastern Region																		
E-Saan Sugar Industry	25/11/47	21/3/48	117	381840.08	544669.15	926509.23	12.87	332575	0	332575	72845.95	0	728459.5	0	1061034.5	114.52	41663.36	44.97
Mitr Kalasin	23/11/47	*2/3/48	100	898552.72	672287	1570839.72	12.90	264173	410922.9	675095.9	119738.26	43657	1241039.6	0	1916135.5	121.98	62248.73	39.63
Kaset Phol	23/11/47	*4/3/48	102	424250.39	742904.27	1167154.66	12.72	482904	0	482904	61500.89	233013	848021.9	0	1330925.9	114.03	49542.26	42.45
Korach Industry	1/12/47	21/3/48	111	998034.56	761053.02	1759087.58	12.58	1399740	65909.92	1465649.92	51118.42	0	511184.2	0	1976834.12	112.38	98473.67	55.98
Mitr Phu Viang	23/11/47	*12/3/48	110	1679084.43	233222.57	1912307	12.78	584490	0	584490	143593.07	173892	1609822.7	41002.8	2235315.5	116.89	76263.7	39.88
Angvian	1/12/47	21/3/48	111	863466.99	569521.38	1432988.37	12.69	591572.5	140066.5	731639	70978.05	194670.5	904451	0	1636090	114.17	76757.31	53.56
N.Y. Sugar	9/12/47	21/3/48	103	428383.1	674235.36	1102618.46	12.62	544382	444350.5	988732.5	19176.625	30581	222347.25	0	1211079.75	109.84	53814.295	48.81
Rerm Udom	3/12/47	*20/3/48	108	742670.93	741871.38	1484542.31	12.74	619794.5	0	619794.5	93938.365	59650	999033.65	0	1618828.15	109.05	61872.58	41.68
Kumphawapi	25/11/47	21/3/48	117	514469.21	769803.73	1284272.94	13.28	639071.5	44200	683271.5	77224.12	0	772241.2	26076	1481588.7	115.36	53800	41.89
Khon Kaen	24/11/47	21/3/48	118	913200.99	1138403.17	2051604.16	12.43	505910	467122	973032	146569.67	0	1465696.7	0	2438728.7	118.87	79288.97	38.65
Saharuang	1/12/47	21/3/48	111	297192.87	464349.42	761542.29	13.49	698372.5	0	698372.5	16845.2	0	168452	0	866824.5	113.82	36914.62	48.47
Burirum	2/12/47	*12/3/48	101	283286.88	413608.5	696895.38	12.57	187504.5	0	187504.5	37119.35	233583.5	604777	0	792281.5	113.69	32732.7	46.97
United Farmer & Industry	29/11/47	21/3/48	113	1733521.7	294409.1	2027930.8	12.56	331765	823581	1155346	110527.02	0	1105270.2	0	2260616.2	111.47	100850.47	49.73
Total				10157954.85	8020338.05	18178292.9	12.74	7182254.5	2396152.82	9578407.32	1021174.99	969047	11180796.9	67078.8	20826283.02	114.57	824222.665	45.34
Grand Total				25108547	22707546	47816093	12.17	17996539.8	6633706.32	24630246.12	2598596.592	1059810.5	27045776.42	68359.3	51744381.84	108.22	2248836.882	47.03

REPORT ON CANE SUGAR PRODUCTION IN THAILAND

CROP YEAR 2003/2004

SEASON ENDING VERSION

Factory Name	Opening Date	Closing Date	Operated Day	Ton Cane Crashed (Tons)			C.C.S.	REFINED SUGAR			RAW SUGAR			Other Sugar Ton	Grand Total Ton	Sugar/ Ton Cane	Final Molasses Ton	Final Molasses / Ton
				Cane	Burnt Cane	Total		White Sugar	Refined Sugar	Total	Bulk	Bag	Total					
North Region																		
Mae Wang Sugar Industry	7/12/46	7/3/47	92	113,835.131	94,898.509	208,733.640	12.47	125,088.00	0.00	125,088.00	8,872.768	0.00	88,727.68	0.00	213,815.68	102.43	11,494.000	55.07
Uttaradit Sugar Industry	13/12/46	12/4/47	122	128,212.650	155,145.830	283,358.480	12.46	115,000.00	0.00	115,000.00	19,558.940	0.00	195,589.40	0.00	310,589.40	109.61	12,953.050	45.71
Thai Identity	13/12/46	2/4/47	112	999,826.290	733,640.960	1,733,467.250	12.73	232,342.00	587,971.00	820,313.00	118,913.750	0.00	1,189,137.50	0.00	2,009,450.50	115.92	78,989.900	45.57
Kampangpetch	16/12/46	28/3/47	104	142,638.340	664,297.350	806,935.690	11.31	313,206.50	0.00	313,206.50	54,316.700	0.00	543,167.00	0.00	856,373.50	106.13	35,548.000	44.05
Ruamphol Nakhonsawan	13/12/46	5/4/47	115	297,094.790	1,094,290.330	1,391,385.120	11.73	380,788.00	0.00	380,788.00	108,911.860	0.00	1,089,118.60	0.00	1,469,906.60	105.64	54,975.000	39.51
Nakornpetch	17/12/46	7/4/47	113	339,605.960	2,096,875.710	2,436,481.670	11.99	496,353.00	525,304.50	1,021,657.50	158,207.000	0.00	1,582,070.00	0.00	2,603,727.50	106.86	94,469.460	38.77
Kaset Thai	7/12/46	23/4/47	139	1,578,061.310	3,131,108.320	4,709,169.630	12.29	1,038,844.00	546,609.50	1,585,453.50	347,247.260	2,600.00	3,475,072.60	0.00	5,060,526.10	107.46	220,508.705	46.83
Thai Roong Runag	9/12/46	7/4/47	121	1,050,726.250	989,427.420	2,040,153.670	12.30	708,691.00	329,920.00	1,038,611.00	120,615.780	0.00	1,206,157.80	0.00	2,244,768.80	110.03	92,375.450	45.28
Phitsanulok	16/12/46	31/3/47	107	177,264.820	1,258,857.480	1,436,122.300	11.91	563,900.00	11,225.00	575,125.00	95,318.250	0.00	953,182.50	0.00	1,528,307.50	106.42	65,160.000	45.37
Total				4,849,899.641	10,233,482.579	15,083,382.220	12.16	3,995,302.50	2,001,030.00	5,996,332.50	1,032,963.308	12,528.00	10,342,161.08	0.00	16,338,493.58	108.32	667,939.815	44.28
Central Region																		
Singburi	9/12/46	13/4/47	127	302,410.070	998,167.090	1,300,577.160	11.88	164,653.50	320,823.00	485,476.50	90,682.740	0.00	906,827.40	0.00	1,392,303.90	107.05	60,590.100	46.59
Suphanburi Sugar Industry	13/12/46	4/4/47	114	102,232.520	295,200.800	397,433.320	11.48	0.00	120,654.00	120,654.00	26,750.900	0.00	267,509.00	0.00	388,163.00	97.67	17,746.390	44.65
U-Thong	22/12/46	8/4/47	109	655,931.840	217,597.700	873,529.540	11.00	361,811.00	192,953.00	554,764.00	34,075.900	0.00	340,759.00	0.00	895,523.00	102.52	38,925.000	44.56
Thai Multi-Sugar Industry	22/12/46	23/3/47	93	382,779.300	432,828.420	815,607.720	10.87	339,422.00	193,738.00	533,160.00	28,318.200	0.00	283,182.00	0.00	816,342.00	100.09	39,157.960	48.01
Thai Sugar	22/12/46	2/4/47	103	576,585.840	149,782.490	726,368.330	11.48	300,593.50	114,646.50	415,240.00	30,273.200	0.00	302,732.00	0.00	717,972.00	98.84	38,259.000	52.67
Prachup Industry	22/12/46	5/4/47	106	599,939.490	232,656.670	832,596.160	11.32	440,253.00	300,317.50	740,570.50	11,022.350	0.00	110,223.50	0.00	850,794.00	102.19	35,781.210	42.98
Tamaka	22/12/46	23/4/47	124	824,028.930	385,824.680	1,209,853.610	11.05	685,551.50	393,730.50	1,079,282.00	16,503.370	0.00	165,033.70	0.00	1,244,315.70	102.85	55,032.820	45.49
New Krung Thai	22/12/46	20/4/47	121	484,367.800	283,134.110	767,501.910	11.16	410,796.50	301,656.00	712,452.50	6,747.070	0.00	67,470.70	0.00	779,923.20	101.62	34,610.230	45.09
Lin Sugar	13/12/46	15/4/47	125	568,512.210	1,222,660.310	1,791,172.520	11.89	672,525.00	274,132.00	946,657.00	101,568.520	0.00	1,015,685.20	0.00	1,962,342.20	109.56	75,849.000	42.35
Thai Kamchanaburi	22/12/46	15/4/47	116	757,355.070	233,858.670	991,213.740	11.43	895,327.50	0.00	895,327.50	8,596.450	0.00	85,964.50	0.00	981,292.00	99.00	49,010.850	49.45
Mitr Kasetr	22/12/46	5/4/47	106	655,213.710	166,087.850	821,301.560	11.23	508,217.50	0.00	508,217.50	32,164.530	0.00	321,645.30	0.00	829,862.80	101.04	38,248.500	46.57
Mitr Phol	13/12/46	30/4/47	140	1,055,282.110	1,991,709.470	3,046,991.580	11.88	292,293.90	751,809.70	1,044,103.60	217,396.960	0.00	2,173,969.60	694.00	3,218,767.20	105.64	132,264.810	43.41
Ban Pong	22/12/46	1/4/47	102	631,066.350	113,042.350	744,108.700	11.42	151,190.00	370,033.00	521,223.00	22,555.610	0.00	225,556.10	0.00	746,779.10	100.36	32,270.350	43.37
Rajburi	22/12/46	26/4/47	127	752,062.980	115,715.110	867,778.090	11.37	683,124.50	123,832.00	806,956.50	6,243.590	0.00	62,435.90	0.00	869,392.40	100.19	42,447.300	48.91
T.N. Sugar	9/12/46	30/4/47	144	1,207,556.080	1,009,710.950	2,217,267.030	11.94	445,622.50	182,478.00	628,100.50	164,918.360	0.00	1,649,183.60	0.00	2,277,284.10	102.71	127,488.920	57.50
Pranburi	15/12/46	11/4/47	119	547,786.870	74,453.420	622,240.290	11.72	327,911.00	94,787.00	422,698.00	23,008.390	0.00	230,083.90	0.00	652,781.90	104.91	24,110.525	38.75
Saraburi	9/12/46	14/4/47	128	1,528,205.820	893,689.800	2,421,895.620	12.13	629,383.00	371,998.00	1,001,381.00	169,467.210	0.00	1,694,672.10	0.00	2,696,053.10	111.32	119,838.520	49.48
Total				12,521,293.000	9,377,818.850	21,899,111.850	11.62	7,742,130.40	4,259,310.20	12,001,440.60	1,081,518.680	0.00	10,815,186.80	977.00	22,817,604.40	104.19	1,025,951.485	46.85
Eastern Region																		
New Kwang Soon Lee	15/12/46	30/4/47	138	230,693.580	424,303.860	654,997.440	10.52	212,083.50	141,678.50	353,762.00	14,072.660	152,805.95	293,532.55	0.00	647,294.55	98.82	28,384.040	43.33
Cholburi Sugar	15/12/46	26/3/47	103	89,238.250	252,383.860	341,622.110	10.43	105,777.00	0.00	105,777.00	20,261.550	0.00	202,615.50	0.00	308,392.50	90.27	14,163.610	41.46
Cholburi Sugar & Trading	16/12/46	19/3/47	95	202,661.360	424,453.510	627,114.870	10.73	436,646.00	50,237.00	486,883.00	14,816.680	0.00	148,166.80	0.00	635,049.80	101.27	25,424.310	40.54
Eastern Sugar	13/12/46	2/4/47	112	695,662.060	936,916.580	1,632,578.640	11.99	407,640.50	277,319.00	684,959.50	88,324.550	200,323.50	1,083,569.00	0.00	1,768,528.50	108.33	79,402.000	48.64
Rayong	15/12/46	25/3/47	102	138,678.650	95,596.970	234,275.620	11.03	204,198.00	5,160.00	209,358.00	2,195.000	0.00	21,950.00	0.00	231,308.00	98.73	12,828.000	54.76
Total				1,356,933.900	2,133,654.780	3,490,588.680	11.27	1,366,345.00	474,394.50	1,840,739.50	139,670.440	353,129.45	1,749,833.85	0.00	3,590,573.35	102.86	160,201.960	45.90
Northeastern Region																		
E-Saan Sugar Industry	25/11/46	12/4/47	140	722,076.120	296,348.780	1,018,424.900	12.48	374,095.00	0.00	374,095.00	79,295.710	0.00	792,957.10	0.00	1,167,052.10	114.59	38,249.910	37.56
Mitr Kalasin	23/11/46	21/3/47	120	1,304,925.700	396,703.670	1,701,629.370	12.68	246,999.00	497,696.30	744,695.30	115,342.700	120,146.50	1,273,573.50	13,686.00	2,031,954.80	119.41	68,936.820	40.51
Kaset Phol	23/11/46	31/3/47	130	714,918.500	747,045.050	1,461,963.550	12.82	465,113.50	0.00	465,113.50	72,639.550	446,621.50	1,173,017.00	0.00	1,638,130.50	112.05	58,098.500	39.74
Korach Industry	1/12/46	30/4/47	152	1,810,998.070	670,388.070	2,481,386.140	11.92	2,043,990.00	40,510.00	2,084,500.00	61,483.360	12,000.00	626,833.60	0.00	2,711,333.60	109.27	136,125.850	54.86
Mitr Phu Viang	26/11/46	8/4/47	135	2,273,296.850	233,342.360	2,506,639.210	12.76	626,063.75	0.00	626,063.75	210,660.490	205,990.50	2,312,595.40	25,501.36	2,964,160.51	118.25	96,492.400	38.49
Angvian	1/12/46	30/4/47	152	2,060,525.490	428,138.200	2,488,663.690	12.53	742,872.50	148,057.50	890,930.00	140,874.250	464,643.00	1,873,385.50	0.00	2,764,315.50	111.08	122,807.730	49.35
N.Y. Sugar	7/12/46	30/4/47	146	970,647.090	741,241.880	1,711,888.970	12.27	782,312.50	572,239.00	1,354,551.50	24,965.290	275,968.50	525,621.40	0.00	1,880,172.90	109.83	81,899.385	47.84
Rerm Udom	8/12/46	9/4/47	124	1,125,483.900	766,982.000	1,892,465.900	12.56	880,385.00	0.00	880,385.00	103,080.016	66,905.00	1,097,705.16	0.00	1,978,090.16	104.52	82,154.720	43.41
Kumphawapi	24/11/46	30/4/47	159	829,138.580	623,735.610	1,452,874.190	13.06	491,064.50	338,486.00	829,550.50	80,343.650	0.00	803,436.50	13,325.20	1,646,312.20	113.31	62,146.000	42.77
Khon Kaen	1/12/46	30/4/47	152	1,786,450.190	632,767.480	2,419,217.670	12.45	1,241,491.25	602,891.00	1,844,382.25	73,444.740	249,676.00	984,123.40	0.00	2,828,505.65	116.92	111,799.870	46.21
Saharuang	24/11/46	2/4/47	131	630,501.660	318,105.310	948,606.970	12.89	1,000,589.50	0.00	1,000,589.50	6,248.490	0.00	62,484.90	0.00	1,063,074.40	112.07	54,489.870	57.44
Burirum	1/12/46	2/4/47	124	603,346.460	407,981.200	1,011,327.660	12.17	321,440.50	0.00	321,440.50	39,653.300	432,601.00	829,134.00	0.00	1,150,574.50	113.77	43,931.640	43.44
United Farmer & Industry	3/12/46	30/4/47	150	2,399,194.360	516,997.390	2,916,191.750	12.70	476,035.50	1,114,939.50	1,590,975.00	172,803.630	0.00	1,728,036.30	0.00	3,319,011.30	113.81	130,110.780	44.62
Total				17,231,502.970	6,779,777.000	24,011,279.970	12.54	9,692,452.50	3,314,819.30	13,007,271.80	1,180,835.176	2,274,552.00	14,082,903.76	52,512.56	27,142,688.12	113.04	1,087,243.475	45.28
Grand Total				35,959,629.511	28,524,733.209	64,484,362.720	12.07	22,796,230.40	10,049,554.00	32,845,784.40	3,434,987.604	2,640,209.45	36,990,085.49	53,489.56	69,889,359.45	108.38	2,941,336.735	45.61

APPENDIX D

POPULATION, AREA AND DENSITY BY STATE AND DIVISION, 2005

State/Division	Male (thousand)	Female (thousand)	Total (thousand)	Area (sq.km)	Population Density (per sq.km)
Kachin	719	734	1543	89042	17
Kayah	161	157	319	11732	27
Kayin	829	845	1674	30383	55
Chin	252	265	518	36019	14
Sagaing	2961	3067	6028	93713	64
Tanintharyi	779	782	1562	43345	36
Bago	2820	2790	5609	39404	142
Magway	2552	2635	5187	44821	116
Mandalay	3824	3915	7739	37935	204
Mon	1440	1428	2868	12297	233
Rakhine	1534	1544	3078	36778	84
Yangon	3209	3251	6460	10171	635
Shan	2659	2647	5306	155801	34
Ayeyarwady	3800	3795	7595	35137	216
Total	**27540**	**27856**	**55396**	**676578**	**82**

Source: Ministry of National Planning and Economic Development, Central Statistical Organization.

APPENDIX E

Ministry of Agricultural & Irrigation, Myanma Sugarcane Enterprise
Sugarcane Production & Milling Progress (25.2.09)

No.	Factory	Plan to Purchase Cane (MT)	Contract Cane(MT)	Milling Progress											
				Cane Purchase		Cane Crushed		Sugar Produced		Reco. of Sugar		Molasses Pro.		Reco. of molasses	
				Today	To date	Today	To date	Today	To date	Today	To date	Today	To date	Today	To date
	Bago East	**260000**	**133667**		**192350.85**		**192350.85**	**8.75**	**15995.25**		**8.32**	**12.63**	**7177.00**		**3.73**
	Pyinmana Factories	**80000**	**15060**		**72141.32**		**72141.32**	**8.75**	**5582.85**		**7.74**	**12.63**	**2246.00**		**3.11**
1	No.(3)Pyinmana	60000	11483		57535.90	Closed	57535.90		4320.95		7.51		1786.00		3.10
2	No.(15)ShweNyaung	20000	3577		14605.42		14605.42	8.75	1261.90		8.64	12.63	460.00		3.15
	Taungngu Factories	**180000**	**118607**		**120209.53**		**120209.53**		**10412.40**		**8.66**		**4931.00**		**4.10**
3	No.(5)Myohla	90000	42607		59617.39	Closed	59617.39		5395.35		9.05		2325.00		3.90
4	No.(6)Yedarshe	90000	76000		60592.14	Closed	60592.14		5017.05		8.28		2606.00		4.30
	West Bago	**155000**	**88374**	**154.11**	**127538.46**	**715.00**	**126859.71**	**7.98**	**12669.75**	**10.21**	**9.99**	**33.00**	**6154.32**	**4.62**	**4.85**
	Pyay Factories	**155000**	**88374**	**154.11**	**127538.46**	**715.00**	**126859.71**	**7.98**	**12669.75**	**10.21**	**9.99**	**33.00**	**6154.32**	**4.62**	**4.85**
5	No. (12)Nawaday	150000	86858	154.11	124337.95	715.00	123659.20	7.98	12426.15	10.21	10.05	33.00	6025.32	4.62	4.87
6	No.(16)Kyauktaw	5000	1516		3200.51	Closed	3200.51		243.60		7.61		129.00		4.03
	Total	**415000**	**222041**	**154.11**	**319889.31**	**715.00**	**319210.56**	**81.73**	**28665.00**	**11.43**	**8.98**	**45.63**	**13331.32**	**6.38**	**4.18**
	Total Other Factories				**708399.67**		**707438.85**		**62431.05**		**8.82**		**28305.04**		**4.00**
	MOI (1)				**45753.53**		**45748.64**		**2150.15**		**4.70**		**2047.41**		**4.48**
1	Zayawadi				15084.10	Closed	15084.10		618.45		4.10		754.21		5.00
2	Belin				30669.43	Closed	30664.54		1531.70		5.00		1293.20		4.22
	Eco. Holding				**172786.42**		**172786.42**		**17071.45**		**9.88**		**7825.00**		**4.53**
3	Inngagwa				125387.19		125387.19		13049.50		10.41		5919.00		4.72
4	Oatkan				47399.23	Closed	47399.23		4021.95		8.49		1906.00		4.02
	MEC				**489859.72**		**488903.79**		**43209.45**		**8.84**		**18432.63**		**3.77**
5	Dahatkone				43903.10	25.2.2009	43471.86		3302.80		7.60		1672.00		3.85
6	Taungzinaye				73483.60	25.2.2009	73474.58		5819.20		7.92		3102.90		4.22
7	Oattwin				46625.98	Closed	46625.98		3928.95		8.43		1780.00		3.82
8	YoneSeit														
9	Duyingabo				88095.67	Closed	88095.67		7677.55		8.72		3533.00		4.01
10	Kanbalu				237751.37	25.2.2009	237235.70		22480.95		9.48		8344.73		3.52

	Private Factories	Capacity	Location
1	Madaya	1,000 TCD	Madaya, Mandalay Division
2	Maung Kon	2,000 TCD	Maung Kon, Sagaing Division
3	Shwe Pale	1,500 TCD	Naung Cho, Northern Shan State

Ministry of Agricultural & Irrigation, Myanma Sugarcane Enterprise and Private Sector

Sugarcane Production & Milling Progress (2007-2008) 3.3.2008

No.	Factory	Plan to Purchase Cane (MT)	Contract Cane(MT)	Milling Progress											
				Cane Purchase		Cane Crushed		Sugar Produced		Reco. of Sugar		Molasses Pro.		Reco. of molasses	
				Today	To date	Today	To date	Today	To date	Today	To date	Today	To date	Today	To date
	Bago East	**239000**	**165080**	**243.10**	**153867.52**	**230.63**	**153704.76**	**22.00**	**12716.20**	**9.54**	**8.27**	**9.20**	**5620.85**	**3.99**	**3.66**
	Pyinmana Factories	**102000**	**58757**	**243.10**	**70208.14**	**230.63**	**70045.38**	**22.00**	**5588.05**	**9.54**	**7.98**	**9.20**	**2365.85**	**3.99**	**3.00**
1	No.(2)Pyinmana	50000	38717		34212.54		34212.54		2672.00		7.81		1369.00		4.00
2	No.(3)Pyinmana	32000	17039		20739.26		20739.26		1581.60		7.63		581.00		2.00
3	No.(15)ShweNyaung	20000	3001	243.10	15256.34	230.63	15093.58	22.00	1334.45	9.54	8.84	9.20	415.85	3.99	2.96
	Taungngu Factories	**137000**	**106323**		**83659.38**		**83659.38**		**7128.15**		**8.52**		**3255.00**		**3.89**
4	No.(5)Myohla	75000	60137		49810.45		49810.45		4487.90		9.01		1918.00		3.15
5	No.(6)Yedarshe	62000	46186		33848.93		33848.93		2640.25		7.80		1337.00		3.95
	West Bago	**123000**	**80996**		**122037.00**		**122037**		**11566.35**		**9.48**		**5816.28**		**4.75**
	Pyay Factories	**123000**	**80996**		**122037.00**		**122037.00**		**11566.35**		**9.48**		**5816.28**		**4.75**
6	No. (12)Nawaday	120000	78785		119000.00		119000.00		11353.15		9.54		5694.28		4.75
7	No.(16)Kyauktaw	3000	2211		3037.00		3037.00		213.20		7.02		122.00		4.00
	Total	**362000**	**246076**	**243.10**	**275904.52**	**230.63**	**275741.76**	**22.00**	**24282.55**	**9.54**	**8.81**	**9.20**	**11437.13**	**3.99**	**4.02**
	Total Other Factories				**607040**		**606193**		**51906**		**8.44**		**23900**		**3.49**
	MOI (1)				**34914**		**34914**		**1621**		**4.64**		**1180**		**3.38**
1	Zayawadi				10052		10052		355		3.53		127		1.26
2	Belin				24862		24862		1266		5.09		1053		4.24
	Eco. Holding				**155697**		**155697**		**15910**		**10.22**		**6123**		**3.93**
3	Inngagwa				114765		114765		12225		10.65		4623		4.03
4	Oatkan				40932		40932		3685		9.00		1500		3.66
	MEC				**416429**		**415582**		**34375**		**8.27**		**16597**		**3.99**
5	Dahatkone				21083		21083		1586		7.52		378		1.79
6	Taungzinaye				82796		82596		6055		7.33		3359		4.07
7	Oattwin				28692		28692		2328		8.00		1141		3.98
8	YoneSeit														
9	Duyingabo				71190		71190		6542		9.19		2967		4.17
10	Kanbalu				212668		212021		17864		8.43		8752		4.13

	Private Factories	Capacity	Location
1	Madaya	1,000 TCD	Madaya, Mandalay Division
2	Maung Kon	2,000 TCD	Maung Kon, Sagaing Division
3	Shwe Pale	1,500 TCD	Naung Cho, Northern Shan State

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Sugarcane Production & Milling Progress (2006-2007) 22.3.2007

No.	Factory	Plan to Purchase Cane (MT)	Contract Cane(MT)	Milling Progress											
				Cane Purchase		Cane Crushed		Sugar Produced		Reco. of Sugar		Molasses Pro.		Reco. of molasses	
				Today	To date	Today	To date	Today	To date	Today	To date	Today	To date	Today	To date
	Bago East	**330000**	**248210**	**71.65**	**284467.48**	**120.13**	**284467.45**	**16.65**	**24555.25**	**13.86**	**8.63**	**3.00**	**11862.14**	**2.50**	**4.17**
	Pyinmana Factories	**150000**	**103418**	**71.65**	**122390.92**	**120.13**	**122390.89**	**16.65**	**10220.60**	**13.86**	**8.35**	**3.00**	**4915.14**	**2.50**	**4.02**
1	No.(2)Pyinmana	80000	65113		71687.61		71687.58		6287.05		8.77		3207.00		4.47
2	No.(3)Pyinmana	50000	31055		43701.04		43701.04		3330.55		7.62		1464.00		3.35
3	No.(15)ShweNyaung	20000	7250	71.65	7002.27	120.13	7002.27	16.65	603.00	13.86	8.61	3.00	244.14	2.50	3.49
	Taungngu Factories	**180000**	**144792**		**162076.56**		**162076.56**		**14334.65**		**8.84**		**6947.00**		**4.29**
4	No.(5)Myohla	90000	64129		76689.01		76689.01		7093.75		9.25		3104.00		4.05
5	No.(6)Yedarshe	90000	80663		85387.55		85387.55		7240.90		8.48		3843.00		4.50
	West Bago	**102000**	**69386**		**110307.95**		**110307.95**		**10785.93**		**9.78**		**4912.00**		**4.45**
	Pyay Factories	**102000**	**69386**		**110307.95**		**110307.95**		**10785.93**		**9.78**		**4912.00**		**4.45**
6	No. (12)Nawaday	100000	68864		108262.24		108262.24		10660.73		9.85		4820.00		4.45
7	No.(16)Kyauktaw	2000	522		2045.71		2045.71		125.20		6.12		92.00		4.50
	Total	**432000**	**317596**	**71.65**	**394775.43**	**120.13**	**394775.40**	**16.65**	**35341.18**	**13.86**	**8.95**	**3.00**	**16774.14**	**2.50**	**4.25**
	Total Other Factories				**673983**		**673979**		**53503**		**8.40**		**29846**		**4.26**
	MOI (1)				**33496**		**33496**		**1408**		**4.20**		**1477**		**4.41**
1	Zayawadi				16758		16758		659		3.93		731		4.36
2	Belin				16738		16738		749		4.48		746		4.46
	Eco. Holding				**172062**		**172062**		**15891**		**9.24**		**6908**		**4.01**
3	Inngagwa				112577		112577		10966		9.74		4573		4.06
4	Oatkan				59485		59485		4925		8.28		2335		3.93
	MEC				**468425**		**468421**		**36204**		**8.39**		**21461**		**4.35**
5	Dahatkone				58608		58608		4848		8.58		2390		4.08
6	Taungzinaye				95384		95384		5900		7.55		4213		3.88
7	Oattwin				44031		44031		3527		8.01		2301		5,23
8	YoneSeit				44389		44389		3426		7.72		2475		5.58
9	Duyingabo				36879		36875		3503		9.50		1512		4.10
10	Kanbalu				189134		189134		15000		8.98		8570		4.50

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No.	Factory	Plan to Purchase Cane (MT)	Contract Cane (MT)	Milling Progress											
				Cane Purchase		Cane Crushed		Sugar Produced		Reco. of Sugar		Molasses Pro.		Reco. of molasses	
				Today	To date	Today	To date	Today	To date	Today	To date	Today	To date	Today	To date
	Bago East	**359,000**	**240,387**	**715.58**	**299,921**	**962.67**	**299,920**	**118.80**	**22948**	**12.34**	**7.58**	**84.13**	**12857**	**8.74**	**4.16**
	Pyinmana Factories	**206,000**	**118,814**	**619.35**	**170,135**	**0**	**170,134**	**0.00**	**13240**		**7.72**	**0.00**	**7078**		**4.06**
1	No.(1)Dahutkone	50,000	46,586	67.94	46,746		46,746		3644		7.80		1875		4.00
2	No.(2)Pyinmana	105,000	19,262	517.83	76,675		76,674		6001		7.83		3666		4.78
3	No.(3)Pyinmana	35,000	36,211		39,355		39,355		2995		7.61		1308		3.32
4	No.(15)ShweNyaung	16,000	16,755	33.58	7,359		7,359		600		8.15		229		3.11
	Taungngu Factories	**153,000**	**121,573**	**96.23**	**129,786**	**962.67**	**129,786**	**118.80**	**9708**	**12.34**	**7.40**	**84.13**	**5779**	**8.74**	**4.30**
5	No.(5)Myohla	63,000	33,558	96.23	56,198	962.67	56,198	73.30	4339	7.61	7.72	50.00	2360	5.19	4.20
6	No.(6)Yedarshe	90,000	88,015		73,588		73,588	45.50	5369		7.30	34.13	3419		4.65
	West Bago	**199,500**	**130,519**	**26.68**	**177,402**	**0.00**	**177,401**	**0.00**	**15780**		**8.86**	**0.00**	**7430**		**4.14**
	Aung Lan Factories	**124,000**	**80,865**	**26.68**	**96,258**	**0.00**	**96,258**		**8028**		**8.27**		**3920**		**3.98**
7	No. (9)Yonezate	74,000	43,309	26.68	49,562		49,562		4281		8.64		2052		4.14
8	No.(10)Dayindabo	50,000	37,556		46,696		46,696		3747		8.03		1868		4.00
	Pyay Factories	**75,500**	**49,654**	**0**	**81,144**	**0.00**	**81,144**	**0.00**	**7752**		**9.55**	**0.00**	**3510**		**4.33**
9	No. (12)Nawaday	75,000	49,654		80,616		80,616		7720		9.58		3485		4.32
10	No.(16)Kyauktaw	500			528		528		32		6.01		25		4.73
	Total	**558,500**	**370,906**	**742.26**	**477,323**	**962.67**	**477,321**	**118.80**	**38728**	**12.34**	**8.11**	**84.13**	**20287**	**8.74**	**4.25**
	Other Factories	**150,000**			**273,479**		**393,447**		**20193**		**7.38**		**11184**		**4.19**
1	**MOI (1)**	**50,000**			**59,312**		**59,280**		**2386**		**4.11**		**2681**		**4.12**
	Zayawadi	50,000			31,169		31,169		1517		4.87		1412		4.53
	Belin				28,143		28,111		869		3.09		1269		4.51
2	**Eco. Holding**	**40,000**			**104,264**		**104,265**		**9797**		**9.40**		**3959**		**3.80**
	Inngagwa				79,775		79,775		7759		9.73		3215		4.03
	Oatkan	40,000			24,489		24,489		2039		8.32		744		3.04
3	**MEC**	**60,000**			**109,902**		**229,902**		**8010**		**7.18**		**4544**		**4.03**
	Taungzinaye				69,652		69,652		5092		7.31		2814		4.04
	Oattwin	60,000			40,250		40,250		2918		7.25		1730		4.30
	Kanbalu, estimate						120,000								
	TOTAL						**990,768**				**7.94**				

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No.	Factory	Plan to Purchase Cane (MT)	Contract Cane (MT)	Milling Progress											
				Cane Purchase		Cane Crushed		Sugar Produced		Reco. of Sugar		Molasses Produced		Reco. of molasses	
				Today	To date	Today	To date	Today	To date	Today	To date	Today	To date	Today	To date
	Bago East	**470000**	**301966**	**3480.56**	**384045**	**6069.41**	**383983**	**517.65**	**31821**	**8.53**	**8.07**	**271.50**	**16165.50**	**4.47**	**4.04**
	Pyinmana Factories	**200000**	**149752**	**1558.29**	**201032**	**2472.2**	**201024**	**234.45**	**17316**	**9.48**	**8.38**	**95.00**	**7863.00**	**3.84**	**3.77**
1	No.(1)Dahutkone	60000	39342	396.93	47363	1050.00	47363	103.05	4262	9.81	9.00	40.00	1511.00	3.81	3.36
2	No.(2)Pyinmana	80000	58869	1094.24	91980	1299.32	91977	129.35	8434	9.96	9.17	55.00	3909.00	4.23	4.01
3	No.(3)Pyinmana	45000	46271		56462		56462		4352		7.71		2179.00		3.86
4	No.(15)ShweNyaung	15000	5270	67.12	5227	122.88	5222	2.05	268	1.67	5.13		264.00		2.41
	Taungngu Factories	**270000**	**152214**	**1922.27**	**183013**	**3597.21**	**182959**	**283.20**	**14505**	**7.87**	**7.73**	**176.50**	**8302.50**	**4.91**	**4.33**
5	No.(5)Myohla	80000	32588	706.54	47166	1200.00	47112	85.50	3448	7.13	7.32	60.00	2175.00	5.00	4.37
6	No.(6)Yedarshe	110000	69155	947.56	90172	1197.21	90172	103.20	7394	8.62	8.20	65.00	4162.00	5.43	4.50
7	No.(7)Oaktwin	80000	50471	268.17	45675	1200.00	45675	94.50	3663	7.88	8.02	51.50	1965.50	4.29	4.01
	West Bago	**301000**	**221188**	**407.64**	**243407**		**243418**		**21949**		**8.95**		**9591.23**		**3.97**
	Aung Lan Factories	**130000**	**107698**	**61.19**	**94716**		**94727**		**7694**		**8.08**		**3700.00**		**3.77**
8	No. (9)Yonezate	80000	76103	61.19	53916		53916		4166		7.73		1900.00		3.31
9	No.(10)Dayindabo	50000	31595		40800		40811		3528		8.65		1800.00		4.36
	Pyay Factories	**171000**	**113490**	**346.45**	**148691**		**148691**		**14255**		**9.51**		**5891.23**		**4.10**
10	No.(11)InNgagya	80000	68795	346.45	81757		81757		8258		10.10		3040.00		3.97
11	No. (12)Nawaday	90000	44695		65963		65963		5938		9.00		2814.23		4.27
12	No.(16)Kyauktaw	1000			971		971		59		6.10		37.00		3.81
	Total	**771000**	**523154**	**3888.20**	**627452**	**6069.41**	**627401**	**517.65**	**53770**	**8.53**	**8.44**	**271.50**	**25756.73**	**4.47**	**4.01**

APPENDIX F

CLIMATLOGICAL DATA AT SELECTED STATIONS

S.N	Station	State/Division	1995-2004 Average				2004 Actual			
			Annual	Temperature (°C)		Mean	Annual	Temperature (°C)		Mean
			Rainfall in millimeter	Mean max.	Mean min.	Relative Humidity %	Rainfall in millimeter	Mean max.	Mean min.	Relative Humidity %
1	Myintkyina	KACHIN	2410	30.1	19.0	76.1	2746	30.0	18.1	80.7
2	Loikaw	KAYAH	1030	29.4	17.1	68.4	1321	29.1	16.7	67.7
3	Hpa-an	KAYIN	4294	33.6	22.4	76.5	5111	34.1	20.7	73.9
4	Falam	CHIN	1453	23.4	14.2	70.4	1272	23.7	14.1	69.8
5	Monywa	SAGAING	718	34.1	21.5	66.9	824	34.4	21.9	66.4
6	Dawei	TANINTHARYI	5657	32.0	21.2	78.5	4452	32.8	21.4	76.4
7	Bago	BAGO	3280	32.7	20.0	78.9	3363	33.0	20.8	82.5
8	Magway	MAGWAY	906	34.0	19.7	69.9	712	33.9	20.1	72.2
9	Mandalay	MANDALAY	829	34.0	21.9	66.5	704	34.3	22.1	67.5
10	Mawlamyine	MON	5119	32.3	22.4	76.6	5720	32.4	22.5	75.2
11	Sittwe	RAKHINE	4923	30.5	22.0	79.5	5689	30.5	22.0	80.9
12	Yangon	YANGON	2813	33.2	21.1	76.3	2712	33.5	19.0	78.5
13	Lashio	SHAN (NORTH)	1267	29.1	15.2	73.9	1312	28.9	15.4	68.3
14	Taunggyi	SHAN (SOUTH)	1404	25.3	14.8	69.5	1659	25.3	14.6	67.0
15	Keng Tung	SHAN (EAST)	1217	29.4	16.0	71.8	1147	29.5	15.2	70.4
16	Pathein	AVEYARWADY	3302	32.5	22.3	78.7	3055	33.6	22.5	79.8

BIOGRAPHY

Petch Pruksathorn graduated his high school diploma in the year 2001 from Bangkok Christian College, Bangkok, Thailand. He then continued his academic journey by entering Thammasat University and spent two years there and another two years in Nottingham University, England, so as to achieve his bachelor degree in Industrial Engineering from Faculty, Thammasat University and in Manufacturing Engineering and Management, University of Nottingham. First, he was a engineer of Thai Summit Autoparts Industry Co., Ltd. which is a subsidiary company of Thai Summit Group. One year later, he applied to work at Sutech Engineering Co., Ltd. in the Engineering Department. He is currently employing as a specialist of purchasing and planning.