PART I - THEORETICAL OUTLOOK, FRAMEWORK ANALYSIS AND BACKGROUND DOCUMENTATION

BACKGROUND STUDIES

AUSTRALIA

INTRODUCTION

Australia's sugar industry is widely acknowledged as one of the lowest-cost in the world. Australia currently ranks seventh among world sugar producers well behind the European Community (EC), China, India and Brazil, and closely behind the United States and Thailand. Among exporters, Australia is surpassed at the global level only by the EC and Brazil, competing with Thailand for third place. Sugar, first grown experimentally as early as 1820, was not cultivated commercially until the 1860s, when production spread rapidly from northern New South Wales (NSW) up the Queensland Coast. Originally a plantation industry relying upon indentured labour, it became a family-based industry from the late-1890s. By the end of the nineteenth century, there were over 70 small sugar and juice mills operating in Queensland and NSW. Today there are 29 including the recently established small mills in the Ord River.

In its formative years the sugar industry supplied the Australian domestic market, along with imports, but during the First World War, shortages resulted in the stimulation of the industry by the state and federal governments. Australia became a net exporter of sugar in 1923, and at the same time, an embargo was introduced on sugar imports, which remained in effect until 1989.

In 1915 the Queensland government introduced the Sugar Acquisition Act and Regulation of Sugar Prices Act which effectively regulated sugar production in Queensland until 1991 when a new Sugar Industry Bill was introduced. NSW sugar was produced and marketed within this general framework, while a Commonwealth/State agreement allowed the domestic price of refined sugar to be regulated.

From 1923, when Australia became a net exporter of sugar, until 1990, there were only three planned substantial increases in the area assigned for cane growing. These took place in 1953-54 in response to new export market opportunities provided by the then recently negotiated Commonwealth and International Sugar Agreements; in 1964/65 after a period of high world market prices and in 1990/91. There were smaller increases approved in 1975/76 and 1981/82, again in response to dramatically improved (but not sustained) world market prices. Under the prevailing regulatory arrangements, cane could only be grown on assigned areas and only on a fixed proportion (net) of the gross assignment. Mill peaks had been established in 1929 in order to ensure that production was kept in line with domestic consumption requirements plus anticipated export outlets and were only increased in line with market growth. There were also corresponding farm peaks. There was a strong sentiment among sections of the industry, which prevailed well into the seventies that regulation provided some assurance of security, and this position was broadly supported by government.

PRODUCTION

About 95 percent of Australia's sugar are produced in Queensland, one of Australia's seven States located on the northern half of Australia's eastern coast. Most of the remaining production is to the south of Queensland in NSW, and there is a small new growing area in the Ord River district of western Australia.

Most sugarcane is grown in a strip within about 50 km of the Queensland coast, stretching about 2 100 km from Mossman and the Atherton Tablelands in North Queensland to Grafton in northern NSW. There are four growing regions in Queensland, each with between 1 500 and 1 700 growers, and an average farm size around 77 ha NSW has 600 growers with an average farm size of about 33 ha, whereas in western Australia which commenced operations only in 1995 the industry has a target of 560 000 tonnes of cane from 22 farms covering 4 000 ha.

As indicated above, sugarcane growing was initially highly regulated, under various Australian and Queensland government laws. These controlled the land on which cane could be grown, specified the mill to which it could be delivered, and the framework for distributing revenues to growers. However, the Sugar Industry Act of 1991 introduced significant regulatory reforms. Whereas previously cane had to be grown on clearly specified plots of land, the 1991 Act allowed for a more flexible assignment system and eased the process of transfer within a grower's own land holdings, between growers, and between mill areas. One of the most important contributions of the 1991 Act was that it specified that assigned cane area should be increased at least 2.5 percent annually, where previously the assigned area had tended to be stagnant.

The area under assignment has grown rapidly since 1991, and exceeded 400 000 ha for the first time in 1996. While a large area of land has been allocated for increased assignments since 1988, potential for growth still remains. Movements in world prices, exchange rates, and seasonal cultivation conditions are major determinants in the amount of land assigned to grow sugar cane. Growers have responded to the opportunities to expand production as the returns from sugar cane production are currently more favourable than many alternative enterprises, which include tobacco, cattle, vegetable and rice production.

Since 1979 all sugarcane is mechanically harvested. In areas of North Queensland where heavy rainfall occurs, special tracked harvesters with high flotation have been developed for the wet conditions. Both “green harvesting” and “harvesting after burning” are practised, and efforts continue to develop better methods for handling green cane. Partly because of concerns about the environment, the percent of cane harvested green rose from 3 percent in 1982 to over 40 percent by 1995. The growing season lasts for 12 to 15 months. Many farmers practice crop rotation, and after growing several ratoon crops, farmers may then plant a cover crop such as legumes prior to replanting cane. Irrigation is also practised, mainly on the Atherton Tablelands and in Burdekin, Proserpine, Mackay, Bundaberg, Maryborough. In Queensland, about 40 percent of cane land is irrigated.

Transportation of the cane to the mill is done mostly by narrow-gauge railway (tram) lines. Only 6 mills use road transport. The cane transportation system allows for rapid and efficient delivery of cane to the mills, usually within 16 hours to minimize deterioration. In recent years, computerization of the system has greatly increased efficiency.

Over the past ten years, the harvested area of sugarcane increased from 311 000 ha in 1986 to 400 000 ha in 1996, a record level. Correspondingly, sugarcane production increased from around 25 million tonnes in 1986 to 39 million tonnes in 1996, a 56 percent increase. During the same period, sugar production has expanded from around 3.4 million tonnes to 5.3 million tonnes, a more than 50 percent increase. Australia has consistently achieved among the highest yields in the world, and recorded record yields of 97.7 tonnes per ha in 1995 and 97.3 tonnes in 1996.

PROCESSING

Sugar milling in Australia has become more concentrated in recent years. In 1980, 19 companies operated 33 mills; in 1990, 12 companies operated 28 mills. Currently, there are 25 mills in Queensland while 3 operate in NSW, and one in western Australia. In Queensland, there are seven cooperative companies with 10 mills, three public (stock) companies with 14 mills, and one privately-held mill. The three largest groups, the Colonial Sugar Refinery Company (CSR), Bundaberg, and Mackay Sugar Co-operative Association Ltd own 17 of the 25 mills.

CSR Ltd operates about 40 percent of Queensland's milling capacity, and one of the largest mills in the world at Victoria. Bundaberg Sugar Company Ltd is Australia's largest cane grower, with about 7 000 sugarcane hectares, and they are also a large miller accounting for about 15 percent of Queensland's milling capacity at their six mills. Bundaberg is a wholly owned subsidiary of Tate & Lyle PLC. With a refinery with capacity of about 150 000 tonnes a year, Bundaberg is fully integrated in the growing, milling, refining and marketing of sugar. The Mackay Sugar Co-operative Association produces about 750 000 tonnes of sugar at 4 mills in the Central Region. There are over 1 000 shareholders. In 1994, Mackay entered into a joint venture with ED&F Man to produce refined sugar at a new refinery adjacent to the Racecourse mill.

For many years the industry did not crush sugarcane on weekends. At least 75 percent of Queensland's mills now run continuously. This practice lowers costs by allowing for more cane to be processed during the season. The length of the crushing season varies from 18 to 27 weeks. The average mill can crush up to 1.4 million tonnes of cane, a substantial increase from the 200 000 tonnes in 1950, although there is a wide variation among the size of mills.

The Queensland Sugar Corporation (QSC) is a statutory authority established under the provisions of the Sugar Industry Act of 1991. The QSC receives no financial support from the Government, as it obtains funds from its sales of raw sugar before distributing the net proceeds back to the mills. It is responsible for managing the regulation of the quantity and quality of sugarcane and raw sugar produced in Queensland, deciding issues relating to the size of the Queensland sugar industry, acquiring and marketing all raw sugar produced in Queensland and distributing the net proceeds resulting from the marketing to mill owners. The QSC may also acquire, construct, manage and maintain bulk terminals and other storage facilities for the processing, storing and handling of products of the Queensland sugar industry.

After the deregulation of the Australian refining industry on 1 July 1989, the NSW sugar industry withdrew from its previous voluntary participation in the Queensland arrangements. The growers supply three raw cane sugar mills in NSW, of which they are joint owners. Production has risen from under 200 000 tonnes in 1989 to about 250 000 tonnes in 1995.

In NSW, all relations between growers and the New South Wales Sugar Milling Cooperative are handled by contract. Cane growers are required to contribute capital to the Cooperative, which is returned over several years if they choose to leave the industry. By breaking away from the Queensland arrangements, the NSW industry hoped to obtain higher average returns.

The Australian sugar refining industry is currently undergoing a period of significant change that may enable Australia to become an even greater exporter of white sugar in the future. Industry analysts currently estimate that Australia has the capacity to produce around 1.2 million tonnes of white sugar, a significant increase from the 850 000 tonnes capacity prior to 1989. Before the sugar import embargo was removed in 1989, sugar was refined by CSR on behalf of the Queensland Sugar Board. This arrangement covered approximately 95 percent of the Australian market, with the remainder being controlled by Bundaberg sugar.

A joint venture was established in 1989 between the NSW Sugar Milling Cooperative and the Manildra group of companies. This joint venture built the Manildra Harwood refinery at Harwood near Grafton, NSW. This refinery handles all of the sugar produced in NSW and supplies about 20 to 25 percent of the entire domestic refined sugar market with a current capacity of 250 000 tonnes per year. The major Australian refiner is CSR, with Manildra, Bundaberg and Mackay holding the remainder.

A loss of market share has prompted CSR to close refineries in Adelaide and Sydney, which had throughput of around 60 000 tonnes and 250 000 tonnes, respectively, and to upgrade the capacity of the Melbourne refinery. Bundaberg Sugar, which was purchased by the international sugar company Tate and Lyle in 1991, has upgraded its refinery capacity from around 40 000 tonnes to 80 000 tonnes. Mackay Refined Sugars, a partnership between the Mackay Sugar Co-op and the British commodities house ED & F Man, commissioned a 350 000 tonnes capacity refinery in April 1994.

The first new cane mill to be built in Australia in seven decades is now in production. The Ord River irrigation area in the Kimberley region of western Australia was the subject of hopes for a number of years, and it appears that earlier problems have now been solved. The first cane crop harvested in 1996 produced 75 000 tonnes of cane, and with an expected sugar content of around 16 percent, sugar production is estimated at 1 200 tonnes. In 1997, it is estimated that the Ord River industry will produce around 40 000 tonnes of raw sugar for the domestic market rising to 60 000 tonnes during the 1998 marketing year. Subsequently, potential would exist for production of around 80 000 tonnes of raw sugar annually. The new industry is expected to target the domestic market in western Australia which consumes around 50 000 tonnes annually, with the remainder going to nearby Asian markets of Indonesia and other South East Asian countries. The Ord River industry has a commercial agreement with the QSC for any potential export marketing of its raw sugar.

CONSUMPTION

At an average of 50 kg per caput per year, Australian sugar consumption exceeds that of European countries at around 40 kg per year, the United States of America at 33 kg and Japan at 20 kg. The Australian industry is constantly monitoring domestic sugar consumption and attitudes to sugar, and adapts its marketing strategies and educational material as needed.

An increasing proportion of sugar is being consumed in manufactured goods, rising from 32 percent in 1938/39 to 72 percent in 1992/93. The percentage shares of key market sectors in domestic industrial sugar consumption in recent years are as follows:

Non-alcoholic beverages	29
Retail sale	23
Confectionery	11
Bakery	8
Preserved foods	8
Alcoholic beverages	7
Dairy foods	5
Other	9

Refined sugar faces its strongest competition in Australia from fermentables such as glucose syrup, starch and some grains

products, which can be used in the production of beer. There is currently one dextrose and one High Fructose Syrup (HFS) manufacturing plant in Australia. The major starch source is wheat, as Australian maize production is limited and often more expensive than wheat. Alternative sweeteners have had difficulty increasing market share due to the aggressive marketing strategies employed by the sugar industry.

In the early nineties, alternative sweeteners accounted for 17 percent of the total sweetener market in Australia, as compared with 14 percent in the mid-eighties. This proportion is lower than in the United States, the EC and Japan. The use of non-nutritive sweeteners in Australia is strongly influenced by food regulations.

The diet soft drink sector leads the demand for non-nutritive sweeteners. Aspartame is a leading sweetener, but some other intense sweeteners have not fared as well. A slump in Australian sales of cyclamates has caused the closure of Australia's only cyclamate producing plant. The expiry of the Nutra Sweet patent at the end of 1992 has resulted in more products using either aspartame or sucralose. Sales of saccharin are expected to increase in the next decade, although the total share of saccharin in the diet sweetener market may decrease as a result of competition from other sweeteners.

TRADE

Outside of Australia and New Zealand, the QSC contracts with CSR Raw Sugar Marketing as agent to handle export sales. C. Czarnikow acts as the QSC's principal sugar broker. The QSC sells sugar directly to end users, rather than sugar traders as is common for most other major exporters.

Prior to 1 July 1997, Queensland raw sugar was sold to domestic refiners (for sale either in Australia or for subsequent export) at an import parity price. Beginning 1 July 1997, when the 15 percent import tariff was abolished upon recommendation of the Sugar Industry Review Working Party (SIRWP), raw sugar may be sold to refiners at an export parity price (i.e., lower than the previous import parity price).

Sugar exports from Australia have risen from about 2.5 million tonnes in the eighties, to a record 4.3 million tonnes in 1996. Australia is well positioned to take advantage of rising demand for both raw and refined sugar in the rapidly-growing Asian market. The main competition is from Thailand, which has significant capacity to export either raw or refined sugar.

The largest importers of Australian sugar in recent years have been Canada, Japan, Malaysia and the Republic of Korea. China is a regular customer, but in 1996 exports to that destination amounted to only 302 000 tonnes compared to 397 000 in 1995 and 720 000 in 1994. Exports to the United States, the only premium market for Australian exports, vary with the size of the import quota. In 1996 exports to the United States amounted to 234 000 tonnes, which was less than 6 percent of Australia's total exports. Asia accounted for around 60 percent of the industry's exports in 1996, compared to just over 30 percent in the seventies. Canada, the largest single market, accounted for nearly 19 percent of exports in 1995-96. The Australian industry recently made sales for the first time to Slovenia, Kazakhstan, Latvia, Croatia, Mexico and the Philippines. Long-term supply arrangements are in place with Canada, Malaysia and Singapore.

Imports were nil prior to the lifting of the embargo in 1989. After rising to 15 000 tonnes in 1991, imports subsequently fell gradually to about 2 000 tonnes in recent years. The main cause of the decline was severe competition from the Australian refined sugar industry, which drove domestic prices below import parity levels.

In 1996, the Queensland and Commonwealth governments established the SIRWP, which reviewed the tariff on raw and refined sugar and the Queensland industry regulatory arrangements. The key conclusions of the review included not only that tariffs should be removed effective from 1 July 1997, but also that the single desk selling function of the QSC should be retained for both domestic and exported raw sugar. In addition, the pool price differential should be phased out over two years. A new producer pricing scheme would be introduced which would not compromise the benefits of compulsory acquisition and single desk selling, while giving cane growers and mills the opportunity to manage their own price risks.

Following implementation of these proposals, the Australian sugar industry would be among the least regulated in the world. The domestic sugar price would not provide higher returns than exported sugar, except to the extent that potential sugar imports would face some transportation costs. Expansion would be largely conditioned by the local situation of mills and growers, although there would remain some central oversight to assure that expansion did not exceed facilities for storage and export.

PRICES

The 1990 season saw the end of administered price arrangements for refined sugar, with domestic sugar prices being determined on the basis of import parity considerations (including the import tariff). However, in July 1997 the import tariff was removed. With sole acquisition rights in Queensland, the QSC was authorized to sell raw sugar to domestic refiners at prices based on the export parity price of raw sugar. Similar sole acquisition powers also exist in NSW.

In Queensland, proceeds from the sale of sugar are pooled for payments. The QSC acquires all raw sugar production. The revenue is distributed back to mills and growers after being adjusted for net profit or loss arising from risk management activities in currency and commodity futures markets, marketing costs, transportation costs and administration costs incurred by the Corporation. The pooling of funds is done primarily to smooth the effect of price fluctuations, enabling producers to receive an average of prices received during the year and not the sales price on the day their output is physically sold.

Prior to 1990, the “No 1” Pool price mainly consisted of returns from the domestic market and from sugar sold on long term contracts (including the United States sugar quota). Each mill was assigned an amount of sugar output called the "mill peak", and any sugar in excess of the "mill peak" received a lower, “No. 2” Pool, price. Similarly, each grower was assigned a peak entitlement under a cane price formula, and received a cane price based on the “No. 2” pool price for cane production above the peak entitlement.

The 1989 crop was the last season in which the difference between the No. 1 and No. 2 pool price was based on the different sales destinations. Since then a fixed (and somewhat arbitrary) difference has been established each year, for example, at 10 percent in 1993, 8 percent in 1994, and 6 percent in 1995 and 1996. For the 1997/98 crop year, the “No. 1” and “No. 2” pool prices would be reduced to 4 percent and then discontinued from 1998/99 onwards.

Technically, sugar produced from cane grown on unassigned land is paid at a penalty rate of A$1 per tonne, but, in practice, this is not a constraint since assignment allocations have been expanding and further liberalization of the assignment system may occur in the future.

Mills test each farmer's cane using a measure called Commercial Cane Sugar (CCS), and payments to the farmers are based on this indicator of the recoverable sugar. In order not to discriminate against farmers who deliver early in the season, there is an adjustment in the payment scale to compensate for early-season deliveries, as these tend to have lower CCS measurements.

FUTURE PROSPECTS

A recent industry study assessed that by 2003 the harvested area of cane in Queensland could expand to nearly 440 000 ha, an increase of nearly 80 000 ha from the area harvested during the 1995 season. Most of the expansion would occur in the Tully, Herbert, Burdekin and Proserpine areas. Production on the Atherton Tablelands, where up to 5 000 ha may be available, has the potential to expand as tobacco growers look to alternative enterprises.

The Australian sugar industry is more directly dependent upon the future direction of the world price than any other major producing country. The industry forecasts that with present capacity, production in 2000 would be about 6 million tonnes, with further strong expansion possible in the longer run, depending of course on domestic and world market developments in the interim. At the international level, the industry's prospects would largely mirror the future direction of world prices, which in turn would depend on the decisions taken in many other countries (particularly other major producers such as Brazil and Thailand); and also on any developments in international trade policies affecting sugar, as for example might result from the next round of multilateral trade talks in World Trade Organization. The growth of world population and income, especially in Asia, should provide an underpinning of support for the world sugar price, and thus the industry's future.

Table 1: Australia sugarcane area, yield and production

Year	Harvested area	Yield	Production
	'000 Ha	*Mt / Ha*	*'000 Mt*
1976	288	81	23 344
1977	295	79.6	23 493
1978	252	85.2	21 457
1979	267	79.2	21 151
1980	288	83.2	23 976
1981	316	79.4	25 094
1982	318	77.9	24 817
1983	307	78.8	24 191
1984	313	81.4	25 450
1985	304	80.3	24 402
1986	311	79.6	24 742
1987	307	80.8	24 832
1988	335	81	27 146
1989	337	79.9	26 940
1990	320	76.2	24 370
1991	341	62.7	21 366
1992	339	86.9	29 461
1993	340	94.2	32 011
1994	366	95.7	34 943
1995	383	97.7	37 438
1996	401	97.3	39 017

Table 2 : Australia sugar production, trade and consumption

Year	Production	Trade		Consumption	
		Imports	Exports	Total	Per caput
	...'000 Mt 94 net titre ...	*.'000 Mt raw equivalent.*			*kg/year*
1976	3 296	0	2 002	785	55.8
1977	3 344	0	2 558	781	55
1978	2 902	0	2 481	782	54.6
1979	2 963	0	1 842	761	52.8
1980	3 330	0	2 203	798	54.8
1981	3 435	0	2 560	791	53.7
1982	3 500	0	2 499	788	52.8
1983	3 171	0	2 549	750	49.5
1984	3 548	0	2 358	780	50.6
1985	3 379	0	2 525	804	51.4
1986	3 371	0	2 751	789	49.7
1987	3 439	0	2 472	766	47.5
1988	3 679	0	2 777	787	48
1989	3 797	8	2 803	826	49.6
1990	3 515	11	2 853	837	49.6
1991	3 100	15	2 614	805	47.1
1992	4 256	12	2 278	893	51.6
1993	4 370	9	3 129	901	51.5
1994	5 080	2	3 457	908	51.4
1995	4 979	2	4 026	887	49.7
1996	5 316	2	4 300	909	50.5

CHINA

INTRODUCTION

With the establishment of new refineries and the adoption of improved technologies, the sugar industry in China has expanded rapidly over the past two decades into a highly integrated industry. Consumption has also increased, and domestic requirements have been met from both domestic production and imports. Although some amounts of sugar are also exported, China is a substantial net importer of sugar. An alternative sweetener industry has also been developed, making China one of the world’s major producers and consumers of

saccharin, however, in recent years health concerns have led to reductions in use.

PRODUCTION

Sugarcane accounts for about 80 percent of sugar production in China, and sugarbeet makes up the balance. About 80 percent of China's sugarcane crop is grown in the South and Southwest regions, including Guangxi, Guangdong, and Yunnan provinces. Production in Guangxi accounts for about 40 percent of the national total, and for the first time in 1993, overtook Guangdong as the leading supplying province. The general trend is for a move from Guangdong to Guangxi, and from eastern Guangxi to its west and Yunnan, as sugarcane gives way to diversification into more profitable crops.

Over 95 percent of sugarbeet production is concentrated in the Northeast and Northwest regions, with Heilongjiang, Xinjiang, and Inner Mongolia contributing about 75 percent of the total. Within this, Heilongjiang and eastern Inner Mongolia account for around 55 percent of total area. However, beet production is facing increased pressure from competing crops in the traditional Northeast area of Heilongjiang, Jilin, and Inner Mongolia. For example, in Heilongjiang the area under beet has shrunk to an average of 319 000 hectares in recent years, compared with a record 426 000 hectares almost a decade ago. Maize is the principal substitute crop, which gives returns twice those of sugarbeet. In Xinjiang, however, production continues to expand with price support and input subsidies to growers from the provincial government.

Producers are free to plant the crops of their choice. The State Planning Commission establishes "guidance" prices for sugar crops and refined sugar, but often neither the industry nor buyers trade at these prices, and the actual price is influenced by local market conditions. Returns from sugarcane are, on average, not as competitive as those from fruits, vegetables, grains, and oilseeds. For this reason, diversification into other crops is pushing sugarcane production from the east to the west of southern China where there is less competition from alternative crops.

Over the last ten years, sugarcane yields have increased somewhat from about 53 tonnes/ha to a peak at 59 tonnes/ha in 1993. During 1990-95, yields averaged 58 tonnes/ha. Yields in the traditional growing areas (Guangdong and Fujian) are generally higher, than those in Guangxi (the main cane-producing province). The higher yields of the former are attributed mainly to irrigation. In 1996, adverse weather and changes in the procurement procedure for sugarcane, from being based on sugar content to total weight of the cane, resulted in a reduction in yields to 51.8 tonnes/ha.

During the past decade, sugarbeet yields have fluctuated along an upward trend, averaging about 19 tonnes/ha over the 1990-95 period. This yield is exceptionally low by world standards. For example, yields in the United States and Europe have averaged 50 tonnes/ha in recent years. Some of the reasons given for the lower yields include drought, plant disease, shorter sunshine hours and smaller differences in temperature between day and night in key growing areas.

Over the last 3 years, sugar production in China averaged 6.6 million tonnes, raw value, which was significantly lower than the record 8.5 million tonnes production in the early 1990s. Sugarcane production during 1994-96 amounted to 65 million tonnes, while beet production was about 14 million tonnes. The decline in sugar production reflected both smaller sugarcane and sugarbeet crops compared to the early eighties.

PROCESSING

The number of sugar mills in China is estimated at approximately 500 (400 for sugarcane and 100 for sugarbeet), with an annual processing capacity of 8.5 million tonnes. The average processing capacity per mill is estimated at 1 500 tonnes/day. The largest mill (in Guangxi) has a processing capacity of 10 000 tonnes/day and the smallest mill only 200 tonnes/day. There are approximately 150 sugar mills with a processing capacity of less than 1 000 tonnes/day. Average recovery rates over the last 3 years has been estimated at between 8.3 percent and 10 percent for sugarcane processing, and 9.1 percent and 12 percent for sugarbeet processing.

CONSUMPTION

While sugar is the major sweetener used in China, saccharin also plays an important role. China's sugar consumption is normally about 7.0 million tonnes, and over the last decade has grown at average annual rates close to 2.0 percent. HFCS and glucose are also produced in China, but do not play a major role.

Per caput sugar consumption averaged 5.9 kg (raw equivalent) in 1995 and 1996. This level is significantly below the world average of around 20 kg. It is also much lower than the consumption in neighbouring Asian countries (51 kg in Malaysia, 20 kg in Republic of Korea, 26 kg in Thailand, 13 kg in Indonesia). The low per caput consumption can be attributed to traditional eating habits, relatively low per caput GDP and the use of substitutes.

Traditionally, the Chinese diet utilizes less sugar in meal preparations. Direct sugar consumption by households accounts for about 50 percent of the total consumption, with the remainder being used industrially for manufactured foods. In comparison with the eighties, the share of direct sugar consumption by households has increased in the nineties, while the share of industrial use has fallen (from its previous level of 65 to 70 percent to the currently estimated 50 percent).

Even within China itself, regional dietary differences affect sugar consumption. For example, sugar consumption in the north is generally lower than in the south, as northerners tend to eat salty rather than sweet foods. In the southern regions, per caput sugar consumption is about 20 percent higher than the nation-wide average. Also, in rural areas, per caput consumption levels, at only around 1.34 kg, are lower than in urban areas. However, in recent years, sugar consumption in urban areas has shown a declining trend, while consumption in rural areas has been trending upward.

Sugar consumption is also affected by the widespread replacement of sugar with saccharin, a high-intensity sweetener. However, in 1991 the safety of saccharin was queried, and stricter regulations were introduced on maximum levels that could be used in various products. In 1993, the Government took further steps to control the manufacture and use of non-nutritive sweeteners. It announced the reduction of cyclamate output by 20 to 30 percent, the halt in construction of new factories, limits on the import of all non-nutritive sweeteners and strict control on their use in food and drink. In recent years, saccharin consumption is estimated at 4 000 to 6 000 tonnes per year, mainly by industry. At this level of consumption, about 1.5 million tonnes to 2 million tonnes of sugar were replaced, which was about 25 percent of normal sugar consumption.

TRADE

The goal of China's sugar policy is self-sufficiency, but this is becoming ever more difficult to achieve as returns from sugar are often lower than the returns from competing crops, and comparative advantage incentives are increasingly influencing planting decisions as the Chinese economy opens up to the world.

China imports sugar primarily from Thailand, Cuba, Australia, Brazil, and Guatemala. Thailand and Cuba accounted for about two-thirds of total imports in 1995. In September 1994, the Government appointed CEROILS, a state-owned company, to be the sole importer. The bulk of the sugar is imported in raw form and processed for domestic consumption. A small proportion is processed and re-exported. Major export destinations include the Russian Federation, Saudi Arabia, Kazakhstan, and the Yemen Republic. In 1993, these countries accounted for about 70 percent of total exports.

Demand for imports and exports fluctuates widely, and makes China a volatile player in the world market. For instance, in 1995 imports rose dramatically to nearly 3.0 million tonnes, and then in 1996, they dropped to 1.4 million tonnes. There are many factors that contribute to this volatility, including incompatibilities resulting from a liberalized sugar market existing alongside the persistent regulatory measures of state institutions. After liberalizing sugar production and marketing in 1992, import and export decisions continued to be made without taking full account of the responses of consumption and production in the liberalized market. In addition, since the prices of major grain crops are still under government regulation, price policies for these crops have an important impact on sugar production because many of them compete with sugar crops.

PRICES

In 1986, the Government relaxed price controls on most crops, except grains and sugar. The immediate effect was a sudden decline in sugar production as many farmers switched to other crops, with a 1 million tonne drop in production in the following year alone. The competitive situation, which developed, has set the tone for potential sugar shortages in the coming decade.

The State Planning Commission sets guidance levels for producer procurement and mill (ex-factory) prices for sugar. These prices can be adjusted up or down depending on changes in the market during the previous year. However, the actual producer procurement and mill prices may deviate from the guidance prices, depending on current local market conditions. This can contribute to imbalances in domestic supply and demand, as producers react to uncertainty in sugar prices when making planting decisions, also taking into account the often more stable returns from other commodities. For grains, procurement prices for grains are guaranteed by the Central Government, which may be more assuring than the procurement prices offered by sugar mills. In cases where sugar mills are unable to pay producers in cash, payment with promissory notes may also dampen producers' intentions to grow sugar crops.

China's mill (ex-factory) prices of sugar are linked to the world price at the port of entry for imports, after adding a 30 percent tariff and a 17 percent value-added tax (VAT) is applied post-tariff. During periods of imports, mill prices at the ports should be about 50 percent higher than the world price.

FUTURE PROSPECTS

Towards the year 2000, China is expected to remain a net importer to fill the shortfall of domestic production. Although net imports could stabilize around 1.0 to 2.0 million tonnes over the next few years, the longer-term outlook is for further increases in imports.

Continued competition from alternative crops is expected to reduce sugar area in traditional growing regions. For sugarcane, production areas are likely to continue shifting from the east towards the west, as land may be diverted to vegetables, fruits, grains, and oilseeds. Despite the guidance prices set for sugar crops, producers may continue to find procurement prices for grains to be more attractive, in addition to the higher returns often obtained from the cultivation of crops not subject to price controls.

The growth in area planted to sugar in regions that are undertaking agricultural expansion may also be limited due to the relatively low returns. For example, the Government's 5 Year Plan in Guangxi calls for an expansion of sugarcane area from 453 300 hectares in 1995 to 466 700 hectares by the year 2000. Even if the plan is fulfilled, the annual growth rate of sugarcane area would only be 0.5 percent, while the average annual increase in sugarcane yields is about 1 to 2 percent.

Thus, domestically produced sugar supplies are not expected to keep pace with the growth in domestic consumption. The population expansion rate has averaged 1.4 percent over the last decade, and this is likely to continue. T here has also been significant income growth during the last decade, which is expected to accelerate in the future. The ongoing growth will most likely increase consumer demand for sugar-based processed foods, beverages, snacks, and desserts. Some analysts believe the growth rate of sugar consumption could be as high as 8 percent annually over the next few years. With increasingly focused government efforts to enhance productivity and improve returns from domestic production, the growth rate of imports may be slowed, but over the longer run China will still need to import large amounts of raw sugar.

Table 1 : China sugarcane and sugarbeet area, yield and production

Year	Harvested area		Yield		Production	
	Cane	Beet	Cane	Beet	Cane	Beet
	'000 Ha	Mt / Ha	'000 Mt			
1976	541	357	30.7	8.2	16 630	2 932
1977	507	352	35	7	17 753	2 456
1978	549	331	38.5	8.2	21 117	2 702
1979	512	325	42	9.6	21 508	3 106
1980	479	442	47.6	14.3	22 807	6 305
1981	551	436	53.9	14.6	29 668	6 360
1982	653	462	56.5	14.5	36 882	6 712
1983	653	543	47.7	16.9	31 141	9 182
1984	728	502	54.3	16.5	39 519	8 284
1985	965	560	53.4	15.9	51 549	8 919
1986	949	520	52.9	16	50 219	8 306
1987	858	497	55.2	16.4	47 363	8 140
1988	924	745	53.1	17.2	49 064	12 810
1989	960	569	50.9	16.2	48 795	9 243
1990	1 009	670	57.1	21.7	57 620	14 525
1991	1 164	784	58.3	20.8	67 898	16 289
1992	1 246	660	58.6	22.8	73 011	15 069
1993	1 088	599	59	20.1	64 194	12 048
1994	1 057	698	57.7	17.9	60 927	12 526
1995	1 125	695	58.1	20.1	65 417	13 984
1996	996	596	51.8	19.1	51 590	11 400

Table 2 : China sugar production, trade and consumption

Year	Production	Trade		Consumption (*)	
		Imports	Exports	Total	Per caput
	...'000 Mt, raw equivalent ...				*kg/year*
1976	1 794	577	153		
1977	1 978	1 598	173	2 268	2.4
1978	2 467	1 299	120	2 768	2.9
1979	2 718	1 096	115	3 068	3.1
1980	2 795	912	235	3 375	3.4
1981	3 441	1 031	136	4 089	4.1
1982	4 186	2 172	73	5 076	5.0
1983	3 868	1 868	66	5 407	5.3
1984	4 691	1 234	57	5 432	5.2
1985	5 549	1 912	196	6 047	5.7
1986	5 730	1 188	289	6 157	5.7
1987	4 706	1 832	492	6 646	6.1

1988	5 356	3 740	269	7 552	6.8
1989	5 668	1 589	467	6 431	5.7
1990	6 880	1 147	620	6 449	5.6
1991	8 578	1 018	373	6 641	5.7
1992	8 402	1 103	1 808	7 589	6.5
1993	6 547	454	2 009	7 136	6.0
1994	5 901	1 558	1 026	6 922	5.8
1995	6 770	2 988	520	7 190	5.9
1996	7 174	1 400	650	7 257	5.9

(*) White sugar

FIJI

INTRODUCTION

Sugarcane is thought to be indigenous to the islands of the South Pacific, and it is certain that several of the world's principal commercial varieties of sugarcane were obtained from this origin. Crystallised sugar was probably first manufactured in Fiji in 1862. During the development of the industry some 35 sugar factories were established, but only four remain today. With one exception, all the early developments of sugar took place in the wetter areas of Fiji, spreading outward from Suva to Levuka. Early planters mistook the general lushness of the wet zone for fertility. Their objective was first and foremost to grow heavy crops, and they paid insufficient attention to the importance of sunlight for the plant to manufacture sugar. Poor drainage was also a problem in some areas. It was for these reasons that many of the earlier sugar enterprises were short-lived.

The foundation of the current sugar industry in Fiji began shortly after the turn of the century, when the Colonial Sugar Refining Company (CSR) became the major player. Its dominant position continued into the early seventies, when in 1971 the agreement relating to the acquisition by Government of the majority shareholding was enacted by Parliament. To make further provision for milling and related activities in the sugar industry, Government created the Fiji Sugar Corporation (FSC) which came into existence on 1 April 1973. FSC, a public company with Government shareholding of 68 percent, is the sole miller and operates the four existing mills. In 1976 Government established the Fiji Sugar Marketing Company Limited (FSM) to market Fiji sugar.

PRODUCTION

Sugarcane is currently grown in the two main islands of Fiji, Viti Levu and Vanna Levu, in proximity to the 4 mills, 3 in Viti Levu and 1 in Vanna Levu (Fig 1). About 22 000 growers currently produce around 4 million tonnes of cane on just under 100 000 ha (74 000 ha harvested annually over the past 4 years). Initially, all cane was grown on estates, but from the twenties lands formerly leased to planters were returned to CSR and developed into the successful (10 acre) tenant farm system still functioning today.

The localization of the sugar industry in Fiji was followed by a steady decline in sugarcane production from about 2.9 million tonnes in 1970 to 2.2 million tonnes in 1975. In 1973 a planned effort to revive cane and sugar production was undertaken. The major thrust of this effort was in the Seaqaqa cane development scheme on Vanua Levu, which together with the world market price peak and the establishment of the Lomé Convention in 1975, contributed to the sustained growth in cane and sugar production from 2.2 million tonnes cane in 1976 to 4.0 million tonnes in 1980, a level which has generally been maintained since then. Production declines have been mainly the result of extreme weather conditions such as the cyclone and drought in 1983 and adverse weather conditions in 1985 and 1987. The Crop Rehabilitation Development Project (CRP) which was implemented following Tropical Cyclone Oscar in 1983 contributed to the recovery in cane production.

Cane production is almost entirely rain-fed, and yields are subject to wide annual fluctuations depending on weather conditions. Average national yields of cane per hectare have increased only slightly over the longer run, from 50 tonnes in 1973-75 to 52 tonnes in 1990-95. In 1996 yields reached 59.2 tonnes per ha. However, sugar content was lower than in 1994, and although cane production was a record the sugar extracted was less than the peak output obtained in 1994 from a smaller amount of sugarcane.

Sugar production averaged 439 000 tonnes during 1990-95, an increase of more than 50 percent compared to 1973-75, immediately after localization of the industry, but prior to the expansion programmes. The growth in production mainly reflected increases in the areas planted to sugarcane. Production reached an all time record in 1994, with 517 000 tonnes sugar from a harvested 4.1 million tonnes of cane, due to favourable weather, but has since stabilized at about 450 000 tonnes.

PROCESSING

There are four mills, which crush cane for the FSC. The Rarawai Mill in Ba commenced crushing in July 1886. Although the mill has been realigned and refurbished, cane has been crushed on that site for 110 years without interruption. After the Rarawai Mill, a mill at Labasa was built in 1894. The Lautoka Mill which commenced crushing in 1903 still is the largest mill in Fiji, and it has now been in operation for 93 years. Finally, the Penang Mill at Rakiraki first started to crush cane in 1881.

The steady rise in Fiji's cane production over the years placed ever-greater demands on the mills. The FSC expanded milling and processing capacities, replaced some obsolete plant and equipment and introduced mechanical sugar handling and storage facilities. Between 1973 and 1996 the combined crushing capacity of Fiji's mills expanded from 14 400 tonnes to over 25 000 tonnes of cane per day. However, because of their age the efficiency of these mills could be improved.

Major capital investments have been made over the years to modernize equipment and improve efficiency. New equipment included the installation of a diffuser at the Lautoka mill to increase crushing capacity; vertical crystallisers at Rarawai and Labasa (installation at Lautoka and Penang is also planned) are designed to improve extraction of sugar from molasses; the installation of boilers and turbo generators at Lautoka in 1995, enabling the FSC to supply power to the Fiji Electricity Authority during harvesting, and in Labasa in 1996, providing that town’s electricity needs during crushing; and bulk storage. handling and loading facilities at the Lautoka and Labasa mills.

CONSUMPTION

Sugar for domestic consumption is produced at the Penang Mill and partly at the Labasa Mill for Vanua Levu consumers. The sugar is a high quality washed raw, polarising at around 98.80 degrees and packed in 35 kg polylined bags. Wholesalers buy the sugar ex-factory and ex-Lautoka Mill store and distribute to retail outlets.

Domestic consumption has steadily increased from 18 000 tonnes (raw equivalent) in 1970 to around 36 000 tonnes in 1996 (Table 1) reflecting mainly population growth. Consumption data have been adjusted downwards to allow for quantities (average 12 000 tonnes) shipped to neighbouring Pacific Island nations. Over the past five years domestic consumption accounted for only 7 percent of production. This percentage is unlikely to change much over the next decade,

and given the fact that the domestic market price is regulated and per caput consumption is already high at 45 kg, the contribution of the domestic market to the overall earnings of the industry is unlikely to vary.

TRADE

The export of sugar accounts for an important share of foreign exchange earnings. In 1995, the value of exports of sugar and molasses accounted for 38 percent of the value of total exports. About 90 percent of production are exported, mainly at premium prices under the Sugar Protocol of the Lomé Convention, and bilateral long-term agreements. Exports have increased by more than 30 percent over the last 5 years, from about 382 000 in 1991 to about 500 000 in 1996.

Fiji was one of the 46 ACP States that signed the Lomé Convention on 28 February 1975. For each of the 13 countries, including Fiji, listed in the Sugar Protocol an annual quota was allocated for imports to the EC. These quantities were given in metric tonnes white value (mtwv), and Fiji's quota was set at 163 600 mtwv, equivalent to approximately 175 000 metric tonnes of raw sugar. The Convention expires in 2000 and negotiation between the contracting parties is expected to commence 18 months before the expiry date of 29 February 2000.

PRICES

Since 1960 the sharing of proceeds from the sale of sugar has been subject to regulation, initially under a rather complicated formula. In 1970, a formula of sharing of proceeds of sale (65 percent to growers and 35 percent to the miller) was introduced and further modified in 1990 under the Master Awards. Under this award, quantities produced up to a base figure of 325 000 tonnes would entitle growers to receive 70 percent and FSC the remaining 30 percent. For quantities above this base up to 350 000 tonnes, proceeds would be shared 72.5 percent for growers and 27.5 for FSC, while for quantities produced above 350 000 tonnes proceeds would be shared on a 75 percent, 25 percent basis. From the gross proceeds certain "industry costs" are deducted e.g. costs of operating sugar industry institutions (Sugar Commission of Fiji, Mill Area Committees), marketing expenses, contributions towards operating expenses of the Research Centre etc.

The devaluation of the Fiji Dollar by 17.75 percent in June 1987 and by a further 15.25 percent in October 1987, had the immediate effect of increasing sugar industry revenue in Fiji dollar terms which resulted in a large increase in the unit price paid to farmers for cane. The cane price rose sharply from F$36.56 per tonne in 1986 to F$52.37 per tonne in 1987 and has remained at between $45 and $55 per tonne during the period 1987 to 1996.

Although the sale of sugar for domestic consumption is not under direct price control, any price increase is subject to Cabinet approval. The price for domestic sugar to wholesalers has remained the same since April 1993, at around US 11.07 cts/lb (US 24.35 cts/kg), and the retail price is around US 16.00 cts/lb (US 35.2 cts/kg).

FUTURE PROSPECTS

Fiji as a small island economy faces obstacles in the development process that are not present in larger countries. With a small population, economies of scale are difficult to achieve in domestic markets, and investments in infrastructure are relatively more costly and often uneconomic. Superimposed on the problems of smallness, Fiji is geographically relatively isolated, prone to natural disasters, and suffers constraints on the availability of land and its productivity.

The past decade has seen fluctuating, but increasing real world market prices of sugar. Medium-term price forecasts range from a small decrease to a substantial increase. However the major concern for Fiji is the quantity sold to the EC under the Sugar Protocol of the Lomé Convention.

The future viability of the sugar industry will depend on being able to produce sugar at a profit at a mix of world market prices and possibly lower returns from shipment to the EC. Low yielding, heavily indebted farms located on marginal lands a long way from mills may find it difficult to survive in the future if such conditions materialize. Other cane farms are expected to remain viable if costs can be reduced. Most of these farmers are likely to continue to consider cane cultivation as the preferred land use option. However in a more competitive environment they, together with FSC, are more likely to be receptive to diversification possibilities.

With the right incentives there is ample scope for the sugar industry to improve efficiency, particularly in the cane growing sector. A recent study undertaken for the industry identified ways yields could be increased by 25 percent with better farming practices. In addition, major efficiency improvements are possible within the existing cane transportation system, by introducing a quality payment system for cane, adopting appropriate mechanisation, and by enhancing labour utilisation. Thus the appropriate policy emphasis should be on improving the efficiency of the existing industry. This is indeed necessary as no single crop or group of crops have been identified that could replace sugar in the foreseeable future.

The Fiji sugar industry, while small, is not insignificant in the context of the world sugar economy. It has a basically sound structure, is relatively efficient (albeit with considerable room for improvement) has sufficient critical mass to reap economies of scale, and has a reputation for good quality product. If the industry can respond to the adjustment challenges it now faces, it has a sustainable future.

Table 1 : Fiji sugarcane area, yield and production

Year	Harvested area *'000 Ha*	Yield *Mt / Ha*	Production *'000 Mt*
1976	47	46.9	2 212
1977	52	51.2	2 674
1978	54	52.4	2 849
1979	62	65.9	4 058
1980	64	52.1	3 360
1981	65	59.7	3 931
1982	69	58.8	4 075
1983	59	37.1	2 203
1984	69	64.8	4 290
1985	71	60.8	3 042
1986	70	58.6	4 109
1987	66	44.5	2 960
1988	64	49.9	3 185
1989	71	58.1	4 099
1990	70	57.6	4 016
1991	73	46.6	3 380
1992	73	48.6	3 533
1993	74	50.1	3 704
1994	74	54.6	4 064
1995	74	55.6	4 110
1996	74	59.2	4 380

Table 2 : Fiji sugar production, trade and consumption

Year	Productio	Trade		Consumption	
		Import s	Exports *	Total	Per caput
	...'000 Mt, raw equivalent				*Kg/yea*
1976	296	0	269	18	30.7
1977	362	0	330	20	32.7
1978	347	0	309	21	35.0
1979	473	0	447	24	38.4
1980	396	0	461	21	33.7
1981	470	0	426	23	36.1
1982	487	0	427	28	42.3
1983	276	14	357	25	36.7
1984	480	6	398	24	34.2
1985	341	0	431	24	33.9
1986	502	12	339	23	31.9
1987	401	1	450	24	33.2
1988	363	0	426	26	36.5
1989	461	0	417	25	34.6
1990	408	0	411	28	38.0
1991	389	1	382	32	43.4
1992	426	26	399	33	44.0
1993	442	2	422	34	44.5
1994	517	1	487	31	40.4
1995	454	2	450	36	46.2
1996	454	2	500	36	45.1

* Includes exports to Pacific Islands

INDIA

INTRODUCTION

In India, government policies, both at the Centre and State levels, have played a crucial role in the development of the sugar industry. The sugar economy in India, like many other countries, is highly regulated, starting from sugarcane to the end-product sugar. Even the by-products are subject to government control. The main objectives of the national policy are to ensure a fair price to cane growers, adequate returns to industry and a supply of sugar to consumers at reasonable prices.

The economics of sugar in India are more complicated than those of sugar industries in many other countries. This is because of the existence of the centrifugal mill industry side by side with a large cottage industry that manufactures open-pan sugar, specifically gur (solidified cane juice) and khandsari (semi-white centrifugal sugar). While the two industries compete for supplies of cane on the demand side, white sugar both complements and substitutes for the products of the cottage industry.

In India the white sugar industry is of considerable economic importance. It is the second largest after the cotton textile industry. Sugarcane farmers and their families, numbering over 35 million, constitute about 7 percent of the rural population. The sugar industry employs 350 000 workers and also provides substantial indirect employment through various ancillary activities.

PRODUCTION

Both area and production of sugarcane fluctuate considerably from year to year. This is due to variations in climatic conditions, the vulnerability of areas cultivated under rainfed conditions, fluctuations in prices of gur and khandsari, and changes in returns from competing crops. Despite this instability, both area and production of sugarcane have increased considerably over the past three decades. The average area under cane increased from 2.4 million ha in the early-sixties to about 3.8 million ha in the mid-nineties. While the total cane area increased by 57 percent during this period, that of rice, which occupies a surface area ten times as large, rose by 23 percent, but the areas planted to sorghum and cotton declined. Uttar Pradesh accounts for nearly half of the total cane area. Other major producing states include Maharashtra and Tamil Nadu (12 percent each), Karnataka (9 percent) and Andhra Pradesh (6 percent).

Rising yields also contributed to the growth in sugarcane production. Yields per ha rose by more than 60 percent from an average of 43 tonnes in the early-sixties to more than 70 tonnes in the mid-nineties. Following rapid increases in productivity in the seventies and early-eighties the rate of growth slackened in the latter part of the eighties. The extension of cane area to marginal lands and the use of varieties susceptible to disease were partly responsible for the slower growth. In the nineties, however, average sugarcane yields again showed strong increases, although some reductions took place in 1996/97.

Total production of sugarcane during the last three decades more than doubled, increasing from an average of l02 million tonnes in the early-sixties to a peak of more than 280 million tonnes in 1995/96. In 1996/97, however, cane production was some 6 percent lower, reflecting reduced plantings and lower yields.

PROCESSING

The Government regulates major aspects of the centrifugal sugar industry including the licensing of factories, the fixation of cane prices, the purchase and distribution of levy sugar and the release of sugar to the open market. In l952 the Government of India took over from the states, the regulation of the sugar industry, under the Industries (Development and Regulation) Act l95l. The l38 factories which were then operating were registered under the provisions of the Act. Thereafter, all new sugar factories and expansion programmes have required licensing by the Central Government, although some relaxation of state controls and simplification of procedures took place in early-1997.

Under each of its Five-Year Development Plans, the Government has provided for additional capacity to meet estimated increasing demand for sugar. Thus, the number of sugar factories rose from 138 in the early-fifties to l73 in l960/6l, and by the mid-nineties their number exceeded 440. In accordance with the Government's policy to shift the sugar industry away from the sub-tropical zone, most of the new factories were licensed in the tropical zone, which currently accounts for 50 percent of operating mills and 60 percent of sugar production.

In the licensing of new capacity, emphasis has been placed on larger, integrated plants to secure economies of scale. The standard size of the plant that in the past was barely l 250 tonnes of cane crushed per day (TCD), is now prescribed under the Government Licensing policy at 2500 TCD. Between the early-sixties and the mid-nineties, mills with a capacity between l250 TCD to 2500 TCD rose from 18 percent to nearly 70 percent, while those below l250 TCD declined from 78 percent to less than 15 percent. However, the average size of Indian sugar units, currently estimated at about 1 900 TCD, is still considerably below that in other major cane sugar producing countries. About 60 percent of white sugar production are supplied by mills in the cooperative sector, 30 percent in the private sector, and 10 percent in the public sector.

Mills face strong competition for cane supplies from gur and khandsari manufacturers. While the mills must operate within

certain government-established cost-return margins, gur and khandsari manufactures may price their products freely, giving them considerable advantage in bidding for cane supplies, particularly in periods of low output, as they can pass on higher prices to the consumer. In addition, certain non-price factors also induce growers to sell cane to non-mill processors in preference to the mill sector. In most areas, gur manufacture is a cottage industry and is within the technological reach of growers. The grower can convert his cane into gur with ease, is thus offered a guarantee against the risk of rejection of his crop by the mill, or of delayed harvesting reducing its quality in terms of sucrose content.

Despite short-term annual fluctuations, there has been a marked increase over the last three decades in the utilization of cane for production of sugar as compared to gur and khandsari reflecting the relatively stronger growth in the market for sugar. During recent seasons, supplies of cane crushed by mills ranged between 43 and 59 percent of total supplies, compared to less than 30 percent in the fifties. There is a wide divergence in the pattern of cane utilization in the various cane producing states of India. In Maharashtra, mills use over 80 percent of the cane produced in the state, while in parts of Uttar Pradesh and Bihar less than 20 percent is used by sugar factories, with most of the remainder being used for the manufacture of gur and khandsari.

India is the largest producer of centrifugal sugar in the world. Total production of sugar has grown very rapidly, but also very irregularly. From an average of 2.6 million tonnes in the early-sixties, production of sugar reached an average of 13.4 million tonnes in the mid-nineties. The variability of production is illustrated by data since the early-nineties, which includes a peak of 17.4 million tonnes in 1995/96 and a low of 9.3 million tonnes in 1993/94.

The goal of expanding sugar production to meet domestic requirements has been reflected in targets under each of India's Five-Year Development Plans since the early-fifties. Output objectives have generally been met, though at the end of the Eighth Plan in 1996/97 actual production is estimated to have fallen short of the target of 14.8 million tonnes of plantation white sugar due to short-term crop fluctuations. By the end of the Ninth Five-Year Plan in 2001/02, the target for output has been set at 19.1 million tonnes.

Aside from being the world's largest producer of centrifugal sugar, India also produces large quantities of gur and khandsari. Production of open-pan sugars has increased, despite yearly fluctuations, from an average of about 6.4 million tonnes in the early-sixties to about 9.5 million tonnes in the mid-nineties. Uttar Pradesh accounts for 60 percent of the total output of gur, followed by Tamil Nadu (16 percent) and Karnataka (10 percent).

The Indian sugar industry suffers from structural problems. Over 40 percent of the factories are more than 40 years old. In a large number of these units, mechanical breakdowns are more than normal, fuel consumption much higher, while extraction rates are well below l0 percent. Thus, in order to modernize and upgrade technology, the Government created the Sugar Development Fund (SDF) in l982, financed through a cess levied on the sugar mills. Of a total of Rs 12 740 million (US$360 million) accumulated in the Fund, as of 30 June l995, Rs 4 892 million (US$140 million) had been sanctioned for modernization and expansion of factories and Rs 4 386 million (US$125 million) for various cane development schemes.

Research and development activities to improve mill efficiency are undertaken at (l) National Sugar Institute, Kanpur; (2) Vasantdada Sugar Institute, Pune; (3) Central Electronics Engineering Research Institute, Pilani; and (4) various Institutes of the Council of Scientific & Industrial Research. A Sugar Technology Mission (SMT), established to upgrade technology in the industry is currently conducting trials in several sugar factories while a system of National Awards for Efficiency has recently been introduced.

CONSUMPTION

In India sugar is an essential item of mass consumption and the cheapest source of energy for the poor. To assure supply of sugar to consumers at a reasonable price, the Government has been following a policy of partial control on sugar distribution under a two-tiered pricing system since l967, excepting for short breaks in l97l/72 and l978/79 when exceptional crop conditions made it impossible to implement dual pricing. The first tier applies to "levy sugar". For this, sugar mills have to supply quotas to the Food Corporation of India at prices, which are set by individual State Governments. The levy price paid to mills in 1996/97 was estimated to be some 15 percent below the cost of production. While the price paid to the mill varies by states, the levy sugar is sold to consumers throughout India at a uniform price.

The remaining domestic supplies of milled sugar, plus any imported supplies are sold at free market prices. The proportion of free-sale sugar has been progressively increased from 35 percent in the mid-seventies to an estimated current level of 60 percent. The annual levy sugar quota has remained around 4.2 million tonnes in recent years, while the free sale volume has risen from about 5.0 million tonnes in the mid-eighties to about 8.0 million tonnes currently.

Total consumption of sugar has increased steadily despite fluctuations in production. These variations were moderated by relatively large stock changes and large imports during periods of severe scarcity such as in 1967 and again from 1985 to 1987 and in 1994. Between the early-sixties and the mid-nineties, sugar consumption rose from about 2.6 million tonnes to about 13.0 million tonnes. During this period, annual per caput consumption increased from 5.3 kg to more than 14.0 kg. Per caput consumption of plantation white sugar in urban areas is higher, about l5 kg compared to a 9 kg estimated for rural areas. Given the distribution of population between urban and rural areas (roughly 30 and 70 percent respectively), urban consumption accounts for nearly 45 percent of the total white sugar utilization.

Consumption of gur and khandsari increased from 6.4 million tonnes to more than 9 million tonnes between the early-sixties and the mid-nineties. However, per caput consumption of these products has actually declined significantly from about 15 kg to 10 kg. On a volume basis, per caput consumption of open-pan sugars was overtaken by that of white sugar in the mid-eighties, reflecting distribution of subsidized levy sugar at times at prices close to the retail price of khandsari and gur, and relatively low prices of free market sugar maintained through the monthly release mechanism and the importation of large quantities of sugar when needed, along with bans on exports. As a result of these measures, sugar recorded the lowest price increase vis-à-vis all other essential commodities such as cereals, pulses, edible oils, and even compared to the alternate sweeteners e.g. gur and khandsari.

TRADE

The policy of the Government is to export sugar on a continuous basis and since 1960 India has been mostly a net exporter of sugar. Until early-1997 the decision to export or not was taken each year, based on expected production and domestic demand, with the surplus, if any, being allowed for export, irrespective of world market conditions. Until then the Indian Sugar and General Industry Export Import Corporation Limited, an organization of the sugar industry, was the only

agency appointed by the Government of India under the Sugar Export Promotion Act of 1958 to handle exports. The Corporation was authorised to recover from all factories on a proportionate production basis any losses suffered on exports when world prices were below costs of production. However, since early-1997 trade has been deregulated, and exporters may register freely for export quotas. Despite ample availabilities from the previous season's peak output, exports in 1996/97 were not expected to increase because of relatively low prices in international trade as compared to the domestic market.

PRICES

Prices of sugarcane are supported through systems operated by the Central and the State Governments. Based on the recommendations of the Commission for Agricultural Costs and Prices, the Central Government announces at the beginning of each season the Statutory Minimum Price (SMP) that mills are required to pay for sugarcane. The SMP is fixed taking into account (a) the cost of cane production; (b) returns to growers from alternative crops and the general price trends of agricultural commodities; (c) the need to ensure availability of sugar to consumers at a fair price; (d) the price at which sugar produced from cane is sold by mills; and (e) the recovery of sugar from cane. The SMP for cane is specified in relation to a basic sucrose recovery level, with a premium for higher values. The SMP has been increased every year since 1988. The SMP for 1996/97 was set at Rs 45.9 (US$1.26) per quintal, more than double the level of the early-nineties.

While the Central Government regulates the sugar industry, the State Governments exercise control over supply and distribution of cane as an agricultural crop. Thus, the State Governments announce State Advised Prices (SAPs) for sugarcane in respect of cane supplied to mills within their boundaries. The SAPs which mills are required to pay are generally substantially higher than the SMP. The prices announced by the State Governments of Punjab, Bihar, Haryana, Uttar Pradesh, Madhya Pradesh and Rajasthan are not connected to the recovery percent in cane, while those announced by the State Governments of Karnataka, Tamil Nadu and Andhra Pradesh are based on recovery rates. In Maharashtra and Gujarat, where cooperative mills dominate the sector, initial payments are slightly higher than the MSP with additional payments at the end of season based on mill profits.

The introduction of the SMPs for cane, their repeated upward revision and the introduction of the SAPS have contributed significantly to the expansion in area and production of cane. The relatively favourable prices obtained by cane growers were reflected in the shift in areas, especially in the eighties, away from wheat and other competing crops to sugar. However, recognising that unduly high SAPs could disturb the inter-crop price parities and lead to distortions in cropping patterns, as well as strain the viability of the sugar industry, the Commission on Agricultural Costs and Prices has recommended that restraint be exercised in fixing the level of the SAPs. In addition, since these price systems provide little incentive to improve quality (in terms of sucrose content), the sugar recovery content of cane has remained stagnant at less than l0 percent for the past two decades, against l2 percent or more in some of the other major cane sugar producing counties.

Within this regulatory framework, the cane growers encounter three different market situations: The first is the unorganized market where cane is sold to the gur or khandsari producers. The second is the private sector sugar mills, and the third the cooperative mills. In each of these markets a different price for cane may prevail. In the unorganized market, the price tends to be the lowest, except in seasons of shortage, when gur producers have greater flexibility to bid for supplies. In the case of co-operative sector mill, the tendency is to offer prices which initially are slightly higher than the Statutory Minimum, while the private sector mills generally pay the State Advised Price (SAP).

Government procurement prices of levy sugar are fixed on the basis of the SMP of cane plus conversion costs as recommended by the Bureau of Industrial Costs and Prices. However, as indicated above, the actual support prices of cane are generally much higher than the prescribed minimum prices.

Consumers use ration cards to purchase public distribution sugar (PDS) at Fair Price shops. The PDS price which had remained unchanged for several years was increased in early-1997 to Rs 10.50 per kg (US 29 cts/ kg). The industry is supposed to offset losses on subsidized levy sugar from the balance sold on the free market. Though there is no price control on free-sale sugar, market supplies are regulated by the Government through a mechanism of monthly release quotas. Prices are thus indirectly maintained at levels considered appropriate by the Government. During the 1996/97 season, free sale sugar wholesale prices rose from about Rs 1 270 (US$35) to some Rs 1 430 (US$40) per quintal. Retail prices also increased to about Rs 1 550 (US$43)per quintal.

FUTURE PROSPECTS

Over the last three decades, production of sugar rose at an average rate of 5.5 percent per year. Following a slackening in growth during the early-nineties, production rose sharply in 1995 and attained a peak level in 1996. Future prospects will continue to be largely dependent on government policy and technological advances, but under current conditions there is potential for production to approach 17 to 18 million tonnes by the end of the decade and 20 million tonnes by 2005.

Although gur and khandsari are still the main sugar products consumed in rural areas, demand for white sugar is expected to continue to increase both in absolute and per caput terms. Rising incomes and urbanization are expected to result in further shifts in demand from open pan to white sugar. Moreover, the growth of sugar demand by food industries and other non-household users, estimated to account for about 40 percent of total utilization, will provide additional impetus to longer term market growth. Under the assumption that pricing and distribution policies remain unchanged, the domestic market could absorb much of the prospective increase in production. In addition, net imports could be needed periodically to offset short-run crop shortfalls. However, if the general liberalization of the Indian economy extends further also to the sugar sector, it may be expected that domestic price levels would adjust upwards, leading to some weakening in the growth of demand and possibly to added incentives to production expansion.

India could generally remain a net exporter of sugar to world markets although availabilities could be constrained by the prospective close balance between supply and demand. The country's net trade position would thus remain vulnerable to short term crop variations, and would consequently continue to constitute an element of uncertainty in the international sugar market.

Table 1: India sugarcane area, yield and production

Year	Harvested area	Yield	Production
	'000 Ha	*Mt / Ha*	*'000 Mt*
1976	2 762	50.9	140 604
1977	2 866	53.4	153 007
1978	3 151	56.2	176 965
1979	3 088	49.1	151 655
1980	2 610	49.4	128 833
1981	2 667	57.8	154 248
1982	3 193	58.4	186 358
1983	3 358	56.4	189 506
1984	3 110	56.0	174 076
1985	2 953	57.7	170 319
1986	2 862	60.0	171 681
1987	3 079	60.4	186 090
1988	3 279	60.0	196 737
1989	3 329	61.0	203 037
1990	3 439	65.6	225 569
1991	3 686	65.4	241 046
1992	3 840	66.1	254 000
1993	3 570	63.9	228 030
1994	3 420	67.2	229 670
1995	3 820	71.0	271 230
1996	3 910	72.4	283 000

Table 2 : India sugar production, trade and consumption

Year	Production	Trade		Consumption	
		Imports	Exports	Total	Per caput
	...'000 Mt, raw equivalent ...			*kg/year*	
1976	4 633	0	899	4 019	6.3
1977	5 261	0	278	4 084	6.3
1978	7 019	0	517	4 948	7.5
1979	6 350	0	771	6 718	10
1980	4 194	136	127	5 662	8.2
1981	5 595	213	109	5 532	7.9
1982	9 170	13	311	6 186	8.6
1983	8 948	0	605	6 515	8.9
1984	6 410	350	166	8 628	11.5
1985	6 630	1 781	51	8 885	11.6
1986	7 507	1 012	8	8 935	11.4
1987	9 099	683	20	9 710	12.1
1988	9 748	0	7	9 823	12
1989	9 365	146	32	11 007	13.2
1990	11 757	13	27	10 992	12.9
1991	12 891	3	184	11 468	13.2
1992	14 341	1	426	12 329	14
1993	11 351	0	197	13 039	14.5
1994	10 604	1 926	53	12 807	14
1995	15 660	140	471	13 322	14.3
1996	17 455	0	900	13 969	14.8

INDONESIA

INTRODUCTION

Indonesia's sugar industry dates back to the seventeenth century. It reached its zenith in the early-thirties when 179 factories produced nearly 3 million tonnes of sugar annually. Following a slump in the thirties, when low sugar prices prevailed, the industry declined to 35 factories producing about 500 000 tonnes of sugar. A decade later the industry had recovered somewhat, and by the beginning of World War II there were 93 factories producing about 1.5 million tonnes. But a second reduction occurred then, so that by the end of World War II only 30 factories remained producing less that 300 000 tonnes. During the fifties some recovery occurred and Indonesia again became a net exporter. However, since 1967, Indonesia has reverted to a net importer position. In 1957, the industry was nationalized and to-date remains highly regulated. The national sugar policy seeks to encourage the intensification of production, the rehabilitation of factories in Java, and the establishment of new factories outside Java to meet growing domestic market requirements arising from steady population growth, rising incomes and the growth of the food and beverage industries. Since the mid-eighties imports have continued to rise and could reach record levels in 1997/98. Rising land and labour costs and rapidly growing consumption make Indonesian sugar self-sufficiency a difficult target to achieve, at least in the short run.

PRODUCTION

Indonesia harvests about 400 000 ha of cane for centrifugal sugar, of which almost three-quarters is on Java. Most of the remainder comes from Sumatra, Kalimantan and Sulawesi. While a decade ago more than half of Java's cane was irrigated, this area has declined reflecting a shift to the cultivation of more profitable crops. Nevertheless, sugarcane cultivation in the major producing islands remains a highly significant economic activity, and covers more than one-third of the total land area.

About 70 percent of the sugarcane areas are cultivated by farmers, mostly on small to medium sized holdings. The remainder is cultivated on sugar factory plantations, both in Java as well as on other islands where the dominant form of sugarcane cultivation is plantation-style. Farmers are organized into groups (Kelompok Tani) responsible for at least 20 ha of land, in order to coordinate the supply of cane to the mills. Sugarcane areas have increased sharply since the mid-seventies at an average annual rate of 7.5 percent from 116 000 ha in 1976 to a peak of 423 000 ha in 1994. However, areas have since declined to 400 000 ha in 1996.

Sugarcane yields have shown little growth, fluctuating during the nineties in the range of 73 to 79 tonnes per ha, compared to an average level of 73 tonnes during the eighties and 83 tonnes during the late-seventies. The average cane yields in the nineties were thus about 8 percent lower than in the mid-seventies, though admittedly on a total harvested area, which was four times larger. During the same period, average paddy rice yields increased by 65 percent, and the area rose by 35 percent. Between the late-seventies and the nineties, average sugar extraction rates also declined from about 10 percent to 7 percent.

Production of sugarcane rose from about 28 million tons in the early-nineties to a peak of 33 million tons in 1994, but subsequently receded to 30 million tonnes in 1995 and 1996. Sugar production showed comparable changes, rising from 2.1 million tonnes in 1990 to nearly 2.5 million tons in 1993 and 1994 and declining to 2.1 million tonnes in 1996.

Sugarcane has had to compete with other crops, especially rice. Relatively less attractive returns as compared to other crops have continued to discourage some farmers from growing cane, leaving certain factories without sufficient raw materials to operate at capacity. In addition, since the 1995/96 season, there has been a weakening in the ratio of producer prices for sugarcane to those for rice. Over the years, aside from price incentives, many Government schemes have been implemented to encourage sugarcane production, including the 1975 Smallholder Sugarcane Intensification Programme and the 1981 Induced Increasing Sugar Production Programme. At

present, the Government provides financial assistance to growers in various forms, for example to support production, harvesting and hauling costs through the Koperasi Unit Desa, or rural cooperative unit. Some funds also flow through the factories to assist with fertilizers and chemicals.

PROCESSING

In 1981 the Government formed the Asosiasi Gula Indonesia (AGI, or Indonesia Sugar Association) comprised of all sugar mills, whether public or private. The AGI is a member of the Indonesian Sugar Council (Dewan Gula Indonesia) and the KADIN (Indonesian Chamber of Commerce and Industry). At present there are some 69 sugar mills in Indonesia, 90 percent of which are publicly owned and organized into management units called Perseroan Terbatas Perkebunan (PTPs). PTBs operate somewhat independently, and many are involved in other businesses such as rubber or palm oil. The share of mills in the private sector is likely to grow if the industry expands as the Government envisages, and if measures are implemented to close antiquated publicly-owned small capacity mills in Java.

At present the total capacity of mills is some 209 000 tonnes of cane per day (TCD). Most mills are small by international standards: 49 have slicing capacity of less than 4 000 tonnes TCD, 12 are between 3 000 and 4 000 and eight are above 4 000 TCD. The efficiency of the small factories is generally relatively low, particularly with regard to the sugar extraction rate. Many countries achieve recovery of over 85 percent of sugar, while Indonesia obtains about 83 percent or less. It is envisaged that by the year 2000, four new sugar factories will be established outside Java with a total capacity of 34 000 to 36 000 TCD and planned sugar production of 445 000 tonnes. By 2005 further sugar processing facilities are planned to bring total production to over 3 million tonnes.

Until 1997, most manufacturers with a demand for highly refined sugar rather than the "standard" domestically produced sugar, depended on imports. The first refinery began operation in mid-1997. It is located in west Java, and will have a capacity to produce 150 000 tonnes of refined sugar per year. The owners include BULOG (a statutory organization), with a 10 percent share, and four other companies. Raw sugar is supplied by Australia, Thailand, Fiji and South Africa.

CONSUMPTION

The population of Indonesia is young and growing rapidly. Average growth since 1970 has been around 2.0 percent annually though rates have slowed in the latter part of this period. Income has also risen rapidly. Since 1970, total real GDP grew by more than 7 percent annually, and on a per caput basis by 5 percent. These factors have led to a strong growth in the use of many consumer products, including sugar and items containing sugar, such as confectionery and beverages. About 90 percent of sugar is used directly by households and 10 percent by industries. Imported refined sugar is largely for industrial use.

Between 1976 and 1996, total sugar consumption increased from 1.8 million tonnes to 2.75 million tonnes, or by an average annual rate of 2.0 percent (Table 2). Per caput consumption rose by about 0.6 percent annually from about 12.9 kg a year in 1976 to 14.4 kg in 1994. Provisional data for 1996 indicate a per caput consumption of 13.5 kg.

It is expected that soft drink consumption growth in Indonesia would provide a stimulus to increased sugar consumption as incomes grow. At present, consumption of soft drinks is well below the levels in Malaysia and the Philippines. In Indonesia there is a large consumption of "tropicals", a juice concentrate which is mixed one part to nine parts water. The concentrate has a very high content of sugar or other sweeteners.

Consumption of sugar substitutes meets a large share of sweetener requirements, particularly in the food and beverage industries. Indonesia now uses about 70 000 tonnes of domestically-produced glucose a year, about 90 percent in candies and 10 percent in miscellaneous other uses. Most of the glucose producers have been small, producing 5 000 tonnes of glucose a year.

The soft drink companies have not generally used HFS, perhaps due to low volume and varying quality. Some increase in HFS production from cassava occurred during the nineties, though constrained by the relatively high cost of the domestic raw material. Production in 1996 was estimated at about 20 000 tonnes, and further increases are expected as a result of a British Sugar/PT Budi Acid joint venture to build a factory of 35 000 tonnes capacity in west Java to produce HFS from cassava. The factory may come on line in 1997.

Indonesia also produces non-nutritive sweeteners such as saccharin, cyclamates and sorbitol for the domestic market and for use in diet beverages. Total production in 1993 was about 10 000 metric tonnes, enough to replace 400 000 tonnes of sugar.

In addition, at least 500 000 tons are consumed of non-centrifugal sugars, sometimes called village cup sugar, and also sweeteners made from palm.

TRADE

Indonesia has been a net importer of sugar since the sixties. Since the mid-eighties, imports have ranged between 50 000 and 350 000 tonnes (Table 2). However, in 1995 imports exceeded 570 000 tonnes, and substantially higher figures are estimated for 1996 and 1997. Lacking a separate refining industry until 1997, Indonesia typically imports refined sugar, or sugars which could be consumed directly.

BULOG is legally the sole importer of sugar and does not pay an import tariff. About five Indonesian firms, and a few international sugar traders, contract with BULOG to handle the actual importation, for which a license is needed.

PRICES

Domestic sugar must be sold to BULOG, although incentives for new private investment include potential waivers for some fraction of output to be sold directly and not through BULOG. Being the sole supplier of both domestic and imported sugar, BULOG plays a key role in sugar pricing.

Each year the Government sets sugar producer prices at a parity level with competitive crops, primarily rice. In recent years, the ratio of the ex-mill sugar prices to the floor price for unmilled rice has weakened. With current sugar producer prices set at Rs 960 (US cents 41.0) per kg and the unmilled rice price at Rs 525 (US cents 22.4) per kg, the price ratio has fallen to 1.83, compared to 2.40 in the early-nineties.
Farmers are paid on the basis of average sugar content of delivered cane, with quality premiums or discounts. In April 1997, in addition to raising the producer selling price of sugar by 5.5 percent to Rs 960 (US cents 41.0) per kg, the Government increased the farmers' share under the production sharing agreement with sugar mills from 62 percent to 65 percent.

Despite higher producer prices, retail prices of domestically produced sugar have been maintained relatively stable in recent years, averaging Rs 1 477 (US cents 63.0) per kg in 1995, and Rs 1 500 (US cents 64.0) per kg in 1996 and the first half of

1997. In real terms (deflated by the consumer price index), prices have declined by about 10 percent over this period. However, these levels may have constrained consumption and encouraged the production and use of substitutes.

FUTURE PROSPECTS

At current real prices, demand for sugar is expected to continue to increase in line with population growth and rising incomes. Given the potential growth in demand, a major challenge facing the Indonesian industry is the extent to which domestic production can be expanded. Despite the dynamic growth in output between the early-eighties and the early-nineties, in more recent years production of sugar appears to have stabilized reflecting the emergence of constraints at both the agricultural and industry level. This has resulted in substantial increases in net import requirements.

Competition for land, particularly irrigated areas, not only from other crops and livestock production, but also increasingly from urbanization in densely populated areas of Java, has resulted in a shift in the cultivation of sugarcane to non-irrigated areas and to poorer lands. Thus, unless yields can be sufficiently increased to enhance the economic viability of crop, possibilities for growth will continue to be dampened. Improved productivity is particularly important because scope for raising producer prices is limited by the need to maintain balanced growth in paddy production, acceptable profit sharing with millers, and adequate margins in the marketing, storage and distribution of supplies without unduly raising retail prices for this essential and sensitive consumer product

In the processing sector, there is also scope for enhancing mill efficiency, thereby contributing to better returns to both industry and agriculture. However, certain structural rigidities make the rationalization of the industry, particularly in the older mills of Java difficult to achieve, including the need to find alternative employment and income opportunities for mill workers.

Table 1 : Indonesia sugarcane area, yield and production

Year	Harvested area '000Ha	Yield Mt/Ha	Production '000Mt
1976	116	82.4	9 558
1977	125	89.5	11 188
1978	153	84.2	12 883
1979	179	77.3	13 837
1980	189	71	13 419
1981	193	68.4	13 208
1982	255	70	17 850
1983	255	75.4	19 247
1984	231	73.9	17 102
1985	273	76.6	20 934
1986	303	77	23 329
1987	335	63.7	21 334
1988	366	78.8	28 804
1989	340	79	26 854
1990	364	76.9	27 976
1991	386	73	28 178
1992	395	79.2	31 248
1993	418	79.5	33 202
1994	423	75.4	31 913
1995	405	75	30 375
1996	400	76	30 400

Given current production and market developments, sugar import demand is expected to remain relatively large by historical standards. However, with the increase in production capacities resulting from new plantations and the larger-scale sugar factories that are being set up outside Java, the projected deficit could be reduced substantially. The longer-term viability of the industry would, however, depend on improved agricultural and industry productivity, particularly as the sector becomes increasingly integrated into the world market and exposed to free market forces.

Table 2 : Indonesia sugar production, trade and consumption

Year	Production	Trade		Consumption	
		Imports	Exports	Total	Per caput
		...'000 Mt, raw equivalent ...			*kg/year*
1976	1 056	219	0	1 791	12.9
1977	1 105	240	0	1 881	13.3
1978	1 320	467	0	1 954	13.5
1979	1 363	318	0	2 068	14.0
1980	1 250	432	0	2 089	13.8
1981	1 247	782	0	2 495	16.2
1982	1 629	745	0	2 387	15.2
1983	1 572	178	0	2 357	14.7
1984	1 500	0	0	2 317	14.1
1985	1 767	1	0	2 219	13.3
1986	1 980	54	0	2 237	13.1
1987	2 086	141	0	2 284	13.2
1988	2 004	141	0	2 316	13.1
1989	2 005	352	0	2 336	13.0
1990	2 075	304	0	2 344	12.8
1991	2 215	330	0	2 489	13.4
1992	2 300	355	0	2 617	13.9
1993	2 483	239	0	2 692	14.1
1994	2 454	120	0	2 805	14.4
1995	2 098	574	0	2 630	13.3
1996	2 100	850	0	2 750	13.5

MALAYSIA

INTRODUCTION

The sugar industry in Malaysia is characterized by rapidly increasing direct domestic consumption supported by an equally fast growing food processing industry, and on the supply side by a small domestic production base that is unlikely to expand. To meet the growth in demand, imports have expanded steadily to record levels in recent years. With excess refining capacity, some of the imports of raw cane sugar are refined and re-exported to regional markets.

PRODUCTION

The cultivation of sugarcane in Malaysia is surprisingly small. Production is concentrated in the Northwest extremity of peninsular Malaysia in the states of Perlis and Kedah (Figure 1). This area has a distinct dry season needed for cost-efficient sugarcane production. Plantings in the states of Perak and Negri Sembilan were unsuccessful due to high unit costs as producing conditions were less suitable. Areas for potential expansion have been identified in the state of Johore and in Sarawak, but no projects have yet been undertaken.

In recent years the sugarcane harvested area has averaged between 20 000 and 24 000 hectares (Table 1). Most of the cane areas is under the management of three sugarcane plantations, two in the State of Perlis and one in the state of Kedah, with smallholders contributing only about 15 percent of the total. The lack of growth in cane areas

largely reflects the higher remuneration received by farmers for other crops, especially oil palm. Over the past 20 years while the sugarcane area has remained at around 20 000 hectares, that planted to oil palm has expanded from 600 000 hectares to 2.2 million hectares. Other leading crops in terms of planted areas are rubber with 1.8 million hectares, rice with 670 000 hectares and cocoa with 380 000 hectares.

Sugarcane yields have increased steadily over the years. They rose from 40 tonnes per hectare in 1980 to 65 tonnes per hectare in 1990 and reached 68 tonnes per hectare in 1996. The increase in yields can be attributed to the planting of improved varieties and greater input use. There are some annual fluctuations, but in recent years yields have remained relatively constant. Differences in yields also exist between plantations and smallholders with the latter's yields averaging generally around 40 tonnes per hectare owing to reduced access to irrigation water.

Production of sugarcane generally ranges between 1.3 to 1.6 million tonnes annually depending largely on yields. Sugar content has been around 7 percent. The harvest takes place between January and April. Labour availability for harvesting is a serious problem for the industry because of increasing employment in the country's manufacturing sector. As the domestic producing area is near the border with Thailand, the sugar industry has come to depend heavily on labour from this country, particularly during the harvesting season. If the harvest is delayed, (e.g. by extended rain) into May or June, labour shortages develop as these workers begin to return home to plant paddy rice in southern Thailand. Because of labour constraints, the industry is planning a gradual shift to mechanical harvesting.

PROCESSING

Malaysia has four sugarcane processing facilities, one each in the states of Perlis, Kedah, Penang, and Selangor. Two of the facilities, Gula Padang in the state of Kedah, and Perlis Plantations in the state of Perlis, are integrated mills processing cane into raw and refined sugar with the added capability of refining imported raw cane sugar. The other two facilities are refineries handling imported raw cane sugar. One is the port-side refinery on peninsular Malaysia across from Penang island owned by the Malayan Sugar Manufacturing Company (MSM). The other is the Central Sugar Refinery (CSR) located near Kuala Lumpur in the state of Selangor. Malaysia's sugar processing industry depends on imports for about 90 percent of its raw materials. With a total annual refining capacity of over 1.0 million tonnes, all of the imported sugar is raw, with the bulk being processed at the MSM and CSR refineries.

CONSUMPTION

Domestic consumption of sugar in Malaysia has increased rapidly in recent years (Table 2). During the first half of the nineties, sugar consumption averaged about 800 000 tonnes annually, compared with about 500 000 during the first-half of the eighties, a 57 percent increase. In 1995, a record 1.03 million tonnes was consumed and the provisional estimate for 1996 places consumption at 1.16 million tonnes. Population and income growth account for most of the gains, as 66 percent of total sugar consumption in Malaysia occurs in the household. However, the country’s buoyant economy has also led to a particularly strong growth in the food processing industry. Ice cream, chocolates, sweetened condensed milk, and soft drinks are some of the items that have created new demand for sugar. On a per caput basis, the level of sugar consumption in Malaysia at about 50 kilograms (raw equivalent) is among the highest of the region. However, some of the sugar-containing products manufactured in the country are exported.

Substitute sweeteners have not made a big impact on the Malaysian market. Apart from limited production of palm sugar which is required for cooking traditional desserts, there is a corn wet-milling plant producing HFCS 42 which is used in the manufacture of tomato and soy sauces. There are no statistics on these sweeteners, but industry sources believe that the quantities involved are insignificant compared to the total sweetener supply.

Non-nutritive sweeteners are making inroads in the Malaysian market. However, the Ministry of Health closely regulates the use of these sugar substitutes. A license is required to import, use, manufacture or sell non-nutritive sweeteners, and detailed records of all transactions must be maintained. These products are limited to use in low-energy or dietary foods and beverages, and all such products must be clearly labelled as containing non-nutritive sweeteners. Relatively few dietary products are manufactured in Malaysia, although diet soft drinks seem to be gaining in popularity. Table sugar substitutes are also becoming more common. However, non-nutritive sweeteners still make up only a small portion of the total sweetener market.

The Malaysian Government estimates domestic requirements each year and sets a quota allocation for refiners and millers to supply the domestic market. Based upon this estimate the refiners and millers are issued licenses to import raw sugar. Quantities imported above these quotas require prior approval. The level of imports permitted is dependent upon expected domestic production and may be adjusted according to the progress of the crop. Tariffs on raw sugar imports are waived for the refiners and mills. Raw sugar imported for re-export as refined sugar is also covered by licenses.

TRADE

Malaysia is a net sugar importing country. In 1995, imports of raw sugar reached a record 1.0 million tonnes, while exports were 101 000 tonnes (Table 2). Increasing quantities of sugar have had to be imported to meet rising demand and compensate for the stagnant domestic production. For example, imports for the first 5 years of the 1990s averaged 885 000 tonnes per year, compared with 494 000 tonnes for the first-half of the 1980s, a 79 percent increase. In recent years, sugar and corn have been Malaysia's largest agricultural imports, with annual sugar imports valued at between US$200 to 300 million.

The main suppliers of raw sugar to Malaysia are Australia, Thailand and Fiji which account for 98 percent of total imports. For a number of years, Malaysia has maintained long term agreements (LTA's) with Australia and Fiji for its sugar supplies. Shipments under these LTA's have accounted for between 40 to 60 percent of annual import requirements. Other import origins have been Cuba and the Philippines, but both have faded in importance since the mid-1980s. Import licensing, administered by the Ministry of Trade and Industry, has replaced the duty levied on imports of refined sugar.

The sugar industry also utilizes its excess refining capacity to produce refined sugar for export. The key markets for that refined sugar have been nearby Singapore and Indonesia, New Zealand and periodically South Asia and Middle Eastern countries, especially Saudi Arabia. The

Philippines have also imported refined sugar from Malaysia in 1994 and

PRICES

Wholesale and retail prices for refined sugar in Malaysia are regulated under the Supplies Regulation Act of 1974 and have remained at M$1 145 (US$452) per tonne and M$1.20 per kilogram (US 47 cents a kilogram), respectively, since November 1989.

FUTURE PROSPECTS

The National Agricultural Policy Plan (NAP) for the period 1992 to 2010 gives minimal attention to sugar compared with oil palm and fruits and vegetables. Apart from encouraging improvement in the productivity of existing areas and milling efficiency, the Government is reportedly not anxious to foster expansion of sugarcane cultivation in the country. However, support is extended to the industry through sugar import quotas and relatively high domestic retail prices. According to the NAP, more research and development efforts are to be channelled to the development of alternative sources for sugar.

Sugar consumption can be expected to continue its upward trend in Malaysia reflecting population and income growth. Higher incomes also translate into growth in the consumption of processed foods containing sugar. Malaysia is likely to import increasing quantities of raw sugar to meet domestic needs. The development of re-export trade appears less certain. Unless refining capacity is expanded, a greater share of domestically processed refined sugar will be retained in Malaysia and less will be available for export. International market developments which would influence trends in exports would include increasing competition from Australia in regional refined sugar import markets and the impact of new raw sugar refineries in the Near East on import demand for refined sugar from countries such as Malaysia. On trade policy, the general view is that LTA's have served Malaysia well, and the agreements with Australia and Fiji are likely to be renewed in the near future.

Table 1 : Malaysia sugarcane area, yield and production

Year	Harvested area	Yield	Production
	'000 Ha	*Mt / Ha*	*'000 Mt*
1976	25	35	870
1977	20	50	1 000
1978	21	45	963
1979	20	50	1 005
1980	18	40	720
1981	17	40	680
1982	20	50	985
1983	21	50	1 025
1984	22	50	1 100
1985	22	49.1	1 080
1986	23	53	1 219
1987	17	71	1 207
1988	19	60	1 140
1989	19	64	1 216
1990	20	65	1 300
1991	20	61	1 220
1992	20	66	1 320
1993	23	68	1 547
1994	23	68	1 541
1995	24	68	1 601
1996	24	68.1	1 600

Table 2 : Malaysia sugar production, trade and consumption

Year	Production	Trade		Consumption	
		Imports	Exports	Total	Per caput
	..'000 Mt. raw equivalent			*kg/year*	
1976	63	337	33	372	29.7
1977	81	408	22	476	37.1
1978	69	395	18	457	34.8
1979	75	418	16	486	36.2
1980	52	491	15	534	38.8
1981	49	452	55	453	32.1
1982	70	421	31	474	32.7
1983	77	543	71	568	38.2
1984	82	561	117	536	35.1
1985	81	593	93	589	37.6
1986	94	646	131	613	38.1
1987	98	639	180	557	33.7
1988	88	710	116	681	40.1
1989	100	772	230	634	36.4
1990	105	815	228	677	37.8
1991	95	874	235	715	39
1992	104	902	258	733	39
1993	106	878	175	797	41.4
1994	114	960	182	880	44.7
1995	108	1 033	101	1031	51.2
1996	113				

PAKISTAN

INTRODUCTION

As is true in many countries, the Government of Pakistan is heavily involved in the sugar industry, regulating mill construction, trade and prices, and influencing farmers' crop decisions in various ways. One reason for the large government involvement with sugar is the political importance of the crop. Sugar is also the second most important cash crop in Pakistan after cotton. Self-sufficiency in sugar is a goal, but one that to date has proven illusive. The major sugar crop is sugarcane, but there is a small sugarbeet industry in the cooler high elevations of the Northwest Frontier Province.

PRODUCTION

Pakistan grows about 1 million hectares of sugarcane, more than all other cane producing countries except Brazil, China, Cuba, India and Thailand. Cane is also used for non-centrifugal sugars and seed, so that the amount of land harvested for centrifugal sugar each year is only about two-thirds of the total.

The Punjab Province accounts for 60 to 65 percent or about 650 000 ha of the area under sugarcane. Rice, cotton, and sunflowers are major competitors for land use among farmers in that province. Other producing areas include the Sind Province which accounts for 25 to 30 percent of sugarcane land, the Northwest Frontier Province (NWFP) about 10 percent, and Baluchistan which accounts for less than 1 percent. In Sind Province, cotton, wheat, rice, and sunflower are alternative crops, and the growing of bananas is becoming more popular. Due to higher yields, the share of Sind Province in total sugar production is about 40 percent.

The harvesting period follows the pattern of many other northern hemisphere crops, beginning in November/December and ending in April/May. Planting can be done in autumn or spring, with autumn planting (September-October) providing

better results due to a longer growing season. Punjab and NWFP mostly plant in spring, and harvest 8 to 10 months later. In the Sind Province most planting is in autumn, allowing growth for up to 16 months. Harvesting begins in October in Sind, November in Punjab and the NWFP, and continues until April or May.

Pakistan's sugarcane yield averages about 46 tonnes per hectare, well below the world average of above 60 tonnes, and below neighboring India's yield of 65 to 70 tonnes. However, yields are increasing over time, at a rate of between 0.5 and 1.0 tonne per hectare annually. Yields in the Punjab, were relatively constant at 37 tonnes per hectare for about 10 years and only recently started rising to over 45 tonnes per hectare. However, individual farmers have obtained yields of 120 tonnes per ha. Precipitation averages only 335 ml a year in the Punjab, so irrigation is crucial, but the total supply of water is limited. Yields in the Sind Province are above 50 tonnes per hectare, significantly higher than in Punjab. The growth rate in sugarcane production in Sind has exceeded Punjab in recent years. However, because of its larger area under sugarcane, the Punjab produces the major share of the national output, and for 1997/98 output in this province is forecast to increase by 10 percent to 29 million tonnes, while Sind is expected to produce 13 million tonnes, unchanged from 1996/97.

Sugar production first rose above 1 million tonnes in 1982. In 1989, output reached 2 million tonnes, and 3 million tonnes in 1994 and 1995 (Table 1). However, production fell to 2.7 million tonnes in 1996 due to a combination of bad weather, lower acreage, and diversion of cane to non-centrifugal sugar production, mostly gur. Production for 1997 is projected at about 3 million tonnes, as farmers respond to the higher prices received the previous year.

PROCESSING

The Pakistan milling sector has grown from 2 mills after World War II to the current 75. Milling capacity is 5 million tonnes of sugar, but the sector is operating at only about 60 percent. Difficulty in acquiring sufficient cane due to competition with non-centrifugal sugar producers (such as gur) is the major factor contributing to the underutilization. Given the sometimes overriding efforts of mills to acquire cane, security of supply for any one mill is low. The other associated problem is the low extraction rate mostly due to deterioration in cane quality. In seeking the highest price for their crops, some farmers are willing to engage middlemen who market their cane to the highest bidder. In certain cases, sugarcane is transported several hundred kilometers, and can be as much as several weeks old by the time it is milled. The poor condition of some roads, and vehicles, adds to this problem.

The issuing of licenses to build new mills is not done according to a set of specific criteria. Mill owners can sometimes get soft government loans to build new mills, and within each province mill ownership is relatively concentrated. With the current over-capacity, many mills are reported to be in financial difficulty, and in recent years some have ceased operating.

There is a waiver of the domestic excise tax for any sugar produced above the average of the previous 2-year period. However, the waiver only applies if the mill grinds continuously for at least 160 days. Mills react to this policy by starting early, running late, or running only part of each day to meet the criteria.

CONSUMPTION

Sugar consumption in Pakistan is growing with the expanding population, and in 1997 is expected to increase to 3.24 million tonnes. In the last 10 years consumption grew at an average of 110 000 tonnes yearly, or over 4 percent a year. In the previous decade (1977-87), consumption had grown much faster at over 10 percent a year when population growth was above 3 percent. In the last decade the population growth rate has declined to 2.3 percent. Per caput sugar consumption continues to rise, but its growth rate has also slowed down from earlier decades, and from 1987 to 1997 it increased only about 1 percent a year.

Per caput sugar consumption in Pakistan, at about 22 kilograms a year, is slightly above the world average and compares to India's per caput use of 15 kilograms. If the consumption of non-centrifugal sugars were added, apparent consumption would be much higher. In 1996/97 it was estimated that 32 percent of the sugarcane crop was diverted for the production of an estimated 1.4 million tonnes of gur. The consumption of gur is difficult to track since there is a large amount of unrecorded trade along the borders of Afghanistan and the Islamic Republic of Iran, where there is a preference for gur. There was a ban on gur before 1987, but now it is freely traded.

There is not much use of other sweeteners in Pakistan. There is a negative public image of saccharin, and many soft drink companies do not sell diet products. The appeal of diet products is limited since sugar is an important source of calories. Approval of Sucralose and/or acesufame-potassium are pending, but any influence on sugar use would mostly likely be only in the distant future. The largest industrial users of sugar are soft drink manufacturers.

TRADE

Pakistan has had brief periods of sugar surpluses, exporting 132 000 tonnes in 1994 and 343 000 tonnes in 1995. These surpluses were short-lived, however, and net imports in 1996 were 340 000 tonnes.

Exports have recently been banned, and imports are under the control of the Trading Corporation of Pakistan. Imports have come mostly from India, Brazil, China and Thailand, with China and Thailand especially being able to provide a type of large-grain sugar which some consumers prefer.

PRICES

The Agriculture Department calculates a detailed cost of production and sets a minimum price for sugarcane based on this calculation. However, in recent years these minimum prices have been lower than the prices which mills have actually paid, due to the shortages of cane. There have been occasional harvest stoppages such as in late 1995 and early 1996 when farmers refused to deliver cane at the minimum price which was being offered by mills. The production of gur provides an alternative outlet for cane.

The price of sugar itself is not directly controlled, though imports and exports are strictly regulated in ways to affect price. In 1996, average retail sugar prices in urban areas were around 18.5 rupees/kg (US 51.28 cents/kg). A less refined grade of sugar, sakria, was selling at 16 rupees (US 44.35 cents/kg), and gur at 14 rupees (US 38.8 cents/kg). The wholesale price of sugar was only slightly lower, at 18 rupees/kg (US 49.9 cents/kg). Outside the cities, sugar prices are generally slightly higher. Some amounts of low priced sugar are sold through government stores to the needy.

In 1997, retail prices rose significantly to 20 to 24 rupees/kg (US 55.4 to 66.5 cents/kg), indicating short domestic supplies. Also, the devaluation of the rupee against the dollar which was highest in 1996 contributed to the rise since sugar is traded internationally in US dollars. As imports have increased in the last 2 years, the rising price of imported sugar (in rupees) was also reflected in the rising domestic price. An import tariff of

10 percent was removed in mid-1997 so as not to contribute to increasing sugar prices.

A "cess" (tax) on sugarcane, half from farmer and half from mill, originally intended to support sugarcane research, is now being used for building feeder roads. The cess varies among the provinces. In 1995/96, the sugarcane development cess in the Punjab, Sind and NWFP were paisas 108, 100 and 53 per 40 kg (about US$ 3.0, 2.8 and 1.5 cents), respectively. The deduction from the sugarcane growers was 54, 25 and 27 paisas (US 1.50 0.69 and 0.75 cents), and from the mills 54, 75, and 27 (US 1.50, 2.08 and 0.75 cents), respectively. These different tax rates affect the net support price, and change the net relative prices received by farmers and mills in the different provinces.

In addition to the announced support price, a premium to be paid to growers who deliver high quality cane is announced each year by the Government. For 1996/97, the quality premium was to be paid if average recovery was higher than 8.5 percent in Punjab and NWFP Provinces, and 8.7 percent in Sind Province. The rate of payment was 0.32 rupees (US 0.89 cents) per 40 kilograms of cane for each 0.1 percent point recovery over the base level. For example, if a Punjab mill averaged 8.6 percent recovery, growers would be paid an extra 0.32 rupees (US 0.89 cents) per 40 kilograms of cane.

The maximum bound import tariff which Pakistan submitted in the Uruguay Round of the GATT was 150 percent ad *valorem* for both raw and refined sugar, which is at the higher end of the range for all developing countries.

FUTURE PROSPECTS

The Pakistan government influences the industry through the price of sugar, price of sugarcane, mill licensing, special types of taxation, and import and export controls (some direct, some indirect). Market-based policies are spreading in many parts of the world, and Pakistan is no exception, although the influence of this trend on sugar policies is not clear.

Pakistan is expected to reduce its sugar imports in the short run, as recent firm internal prices are likely to provide stimulus to domestic production, while constraining the growth of consumption. This would conform to long-stated self-sufficiency goals. However, with clear limits on irrigation water and production inputs, self-sufficiency for Pakistan in any one commodity, such as sugar, may come at the price of foregone production of other crops. The price of refined sugar in the world market in the last decade has been more stable than in earlier decades, and as world trade becomes based more on market-oriented policies, the world price may become a more clear "opportunity cost" against which to compare domestic prices. The currency devaluation which Pakistan has recently experienced provides a window of opportunity for Pakistan's sugar policy to be realized.

However, in the longer run, improved efficiency will be required to create the basis for a competitive industry. There are likely to be ongoing technical efficiency gains in the industry, and Pakistan appears to be well positioned to adopt technological improvements.

Table 1 : Pakistan sugarcane and sugarbeet area, yield and production

Year	Harvested area		Year	Harvested area		Production	
	Cane	Beet		Cane	Beet	Cane	Beet
	'000 Ha			*Mt / Ha*		*'000 Mt*	
1976	700	10		36.5	26.3	25 547	273
1977	788	14		37.5	27.7	29 523	389
1978	823	14		36.6	22.5	30 077	327
1979	753	14		36.3	23.8	27 326	335
1980	719	13		38.3	25.7	27 498	339
1981	825	16		39.2	28.8	32 359	453
1982	947	12		38.6	28.9	36 580	360
1983	912	9		35.7	23.6	32 534	206
1984	897	8		38.2	21.8	34 287	178
1985	904	4		35.6	27.2	32 140	104
1986	780	3		35.7	39.8	27 856	135
1987	762	10		39.3	33	29 926	320
1988	842	12		39.2	38.7	33 029	456
1989	877	11		42.2	30.2	36 976	342
1990	854	11		41.5	31.3	35 494	343
1991	884	11		40.7	30.4	35 989	319
1992	896	9		43.4	35.3	38 865	315
1993	885	8		43	27.8	38 059	233
1994	963	7		46.1	35	44 427	243
1995	1009	8		46.7	25.5	47 168	194
1996	963	8		47	27	45 230	213

Table 2 : Pakistan sugar production, trade and consumption

Year	Production	Trade		Consumption	
		Imports	Exports	Total	Per caput
		…Mt. raw equivalent		*kg/year*	
1976	685	0	0	598	7.7
1977	736	0	0	801	10.1
1978	930	0	0	843	9.9
1979	662	12	0	874	10.4
1980	624	109	0	798	9.2
1981	927	77	0	894	9.9
1982	1 412	0	0	1 086	11
1983	1 247	4	2	1 151	11.8
1984	1 248	0	54	1 281	13
1985	1 430	0	0	1 426	13.9
1986	1 213	281	0	1 754	16.6
1987	1 398	815	0	2 184	19.9
1988	1 936	273	0	2 000	17.7
1989	2 011	47	68	2 293	19.6
1990	2 017	235	8	2 247	18.5
1991	2 100	497	0	2 420	19.1
1992	2 528	127	0	2 641	20.3
1993	2 603	82	0	2 691	20.1
1994	3 177	52	132	2 852	20.8
1995	3 263	6	343	3 026	21.6
1996	2 684	350	10	3 162	21.8

PHILIPPINES

INTRODUCTION

The culture of sugarcane as a commercial crop started in the Philippines in the eighteenth century. By the nineteenth century the crop had adapted to soils and climatic conditions and had become a major export commodity. By the twentieth century, growing demand from the United States fuelled a major expansion of the crop, which together with new technology in sugar milling and the provision of adequate financing, created the Philippine sugar industry. The Laurel-Langley Agreement with the United States which gave practically limitless preferential access to Philippine sugar expired in 1978 and was replaced by the current import quota system which the United States has with selected countries.

In 1974, stimulated by buoyant prices, a monopoly was established to handle all sales of sugar and promote further development of the industry. This monopoly was dismantled in 1985, nationalized sugar mills and refineries were privatized, and the Sugar Regulatory Administration (SRA) was established. The SRA’s major mandate was to rebuild the industry, spur its further development, and regulate inventory

levels. It allocated sugar production quotas to supply domestic markets and fill the Philippine export quota to the United States, with residual sugar being sold to the world market. The SRA does not have authority to itself buy, own, or market sugar.

PRODUCTION

Sugar cane is currently grown in 17 provinces which are widely distributed in 8 regions, from the northernmost island of Luzon to the southernmost island of Mindanao (Figure 1). The island of Negros in the central islands (Visayas) of the country, with its 17 operational mills, remains the primary cane-growing region accounting for about 55 percent of the total land area planted to the crop. Rapid industrialization in Central and Southern Luzon, where Metro Manila is located, has resulted in a significant reduction in hectarage on the island. However, the establishment of new farms on the island of Mindanao has offset some of this reduction and indicates the growth potential of the island for sugar production.

The area under sugarcane has generally declined over the last twenty years from a peak of 553 000 hectares in 1976 to a trough of 269 000 hectares in 1987. Sugarcane production closely followed trends in area, with a peak of 29.3 million tonnes in 1976 to a low of 13.8 million tonnes in 1987. The nineties have been marked by periods of declining productivity, mostly attributed to poor farm cultivation and poor harvesting schedules in addition to insufficient development and extension capability.

In 1976 remunerative prices and assured markets, supported by adequate Government financing led to production of sugar reaching a total of 2.8 million tonnes. However, sugar production declined soon after as the assured market in the United States was subjected to a reduced quota. Price controls in the domestic market and the impact of the Comprehensive Agrarian Reform Programme (CARP) further contributed to the decline in sugar output to a low of 1.2 million tonnes in 1987. Under CARP, plantations in excess of 25 hectares have been redistributed to workers and beneficiaries. As a result of the programme, the average size of sugarcane farms shrank from 14 ha in the seventies to 9 ha in 1993. The distribution of farms in parcels of 3 ha to 5 ha, patterned after rice, and the natural redistribution through inheritance of farms over 100 years, have rendered most single sugar farms uneconomic.

Production has recovered in the nineties and averaged around 1.8 million tonnes from 1990 to 1996 mainly as growers and millers have adapted to the changes brought about by the CARP. For example some mills have begun leasing redistributed lands, so that the production unit is large enough to economically justify mechanization. In addition, supply of cane to the mill becomes secure. Another development is the pooling together of resources by smallholders to form as cooperatives hence achieving economies of scale in the production of cane and securing of supply for the co-operative owned mill. Sugarcane yields currently average about 62 tonnes per hectare while sugar yield is about 4.8 tonnes sugar per hectare, although highs of 100 tonnes cane per hectare and 9 tonnes sugar per hectare respectively have been achieved in most areas where irrigation and appropriate cultural practices have been implemented.

About 41 000 farmers and another 500 000 farm workers are currently involved in cane growing, making the sector one of the largest source of employment in the country. About 80 percent of the 41 000 planters cultivate holdings of 10 hectares and below. Collectively they own only 29 percent of the country's total cane area. Except for about 10 000 hectares of land employing varying degrees of mechanization most farms depend on extensively manual labour and use a mix of tractors and buffalo for ploughing and land preparation.

PROCESSING

The harvesting season commences from October to December depending on whether the area is on the eastern or western seaboard, and ends in May. Rarely does the grinding season exceed 180 days except in the Victorias Milling District in Negros Island, due to even rainfall distribution, but this has been put in question lately as the Philippine window for cane ripening appears to be limited by a dry period of 120 to 150 days.

There are 41 installed sugar mills in the country of which 37, with varying capacities, are operational and mostly are located in the main sugar growing island of Negros. Each mill employs around 500 workers on either a permanent or seasonal basis. In 1991, the sugar industry began implementing a programme to upgrade mills which had been left in a state of disrepair and obsolescence. Half of the mills have been upgraded in the past five years at a total cost of about P10 billion (about US $380 million at 1995 exchange rates). However, others continue to produce inferior sugar which often fetches lower prices and, through lower cane purchase prices, discourages farmers from optimizing farm output. Many in the industry recommend that the SRA be empowered to impose mandatory recovery rates and capacity parameters as conditionalities in granting milling licenses. Most sugar output is in the form of raw sugar (97.5 polarity). Some washed and sulphated white sugars are also produced.

While mechanical time efficiency and mill recovery have improved due to upgraded equipment in some mills, over-all performance has been on a downward trend largely due to low extraction rates of the older factories and overcapacity due to insufficient cane supply. This in turn has led to stiffer competition for cane supplies among millers often leading to long distance hauling and subsequent poor cane quality as the time between harvesting and crushing lengthens. Cane crushing capacity averages about 5 000 tonnes of cane per day.

The refining sector is composed of 16 sugar refineries, 15 of which are annexed to raw sugar mills. Average refining capacity is about 400 tonnes (8 000 50-kilo bags) per day, with Victorias Milling being the biggest with a capacity of 1 250 tonnes (25 000 50-kilo bags) per day. Capacity utilization for the whole sector is about 78 percent using a variety of technologies including carbonation, ion exchange resin, phosphatation, and granular activated carbon. Recovery is about 0.92 tonne of refined sugar per tonne of raw sugar.

CONSUMPTION

Total consumption of sugar in the Philippines was 1.97 million tonnes in 1996, of which about 35 percent was accounted for by industrial utilization. On a per caput basis, this equated to 28.2 kg. Over the past two decades, total consumption of sugar increased at an average annual rate of about 3.5 percent. A household consumption study commissioned by the industry in 1993 concluded that, on a per caput basis, households in the Ilocos region, Metro Manila and Central Luzon had the highest levels of usage at 18.3 kg, 18.0 kg, and 16.6 kg, respectively. Per caput consumption for all other regions ranged from 11 kg to 13 kg. The study also indicated that while total consumption grew by 3.5 percent since the mid-seventies by main user groups the trends differed somewhat household sugar consumption rose by an annual average rate of 3.5 percent; industrial use by 4.6 percent; and by contrast, institutional use declined by 1.8 percent yearly.

TRADE

Sugar trading and marketing in the Philippines, returned to the private sector since 1985, after a prolonged period under government monopoly, is proving to be too fragmented. Sugar mills and planters' associations and cooperatives do not market and sell sugar collectively. As individual planters,

mostly small, they sell their sugar to intermediary traders. This adds to the cost as sugar volumes undergo consolidation prior to refining, as does the subsequent handling by traders, distributors and dealers prior to reaching the retail markets. The present cost of intermediaries in trading is exceptionally high.

Over the past decade exports have declined as domestic consumption increased. From more than a million tonnes exported annually prior to 1985, shipments reached an all time low of 154 000 tonnes in 1995 and indications are that this trend will continue, at least in the short term. Imports, on the other hand, have risen during the same period to a record 827 000 tonnes in 1996. The Government usually defines the use of domestically produced sugar each year to determine the quantity that should be exported. For example, for the 1997/98 crop year, production is forecast at between 1.7 million tonnes and 1.8 million tonnes of which the Philippine Sugar Board has directed millers to set aside 12 percent of milled sugar for exports to the United States and the remaining 88 percent for domestic consumption. The United States Government has set an import quota of 151 015 tonnes of raw sugar from the Philippines for 1997/98.

PRICES

One of the major objective in creating the SRA was for the implementation of a pricing policy which would make sugar farming and milling profitable, while keeping prices to consumers reasonable. In the Philippines as in most major sugar producing countries, this is done by regulating domestic supply within volume parameters that allow market forces to operate within a certain price band. However, in the Philippines, the mechanisms for this regulation, are not clear in their implementing rules, leading to wild swings in prices. In addition, as a result of concessions offered under the Uruguay Round and the ASEAN Free Trade Area Agreement (AFTA), it would seem that import tariffs no longer afford protection to domestic production in the short, and possibly also in the longer term. Without a pricing formula firmly in place to maintain domestic prices at stable levels, it is estimated that a share of farmers would abandon the cultivation of sugarcane.

FUTURE PROSPECTS

It is estimated that about 100 000 additional hectares of land could be made available for sugarcane cultivation in the future, about 50 000 in Luzon and another 50 000 in Mindanao. The Visayan islands of Negros, Panay and Leyte have probably reached their full potential. The present 370 000 hectares under cultivation may soon be reduced by as much as 10 percent due to urbanization and withdrawal of marginal lands because of their low productivity or long distance from sugar mills. Under favourable price conditions, this could mean a net expansion of 63 000 ha.

The integration of mills through the management of large tracts of land is expected to give the mills better control of harvesting programmes and allow them to improve the synchronization of cane harvesting. Inefficient milling operations are at present posing major problems and contributing to significant losses in the sugar content due to delayed crushing of harvested cane.

Finally, analysis of prospective sugar demand, considering price elasticity, comparative trends in other developing economies, and population growth, indicate that the country's consumption of sugar, in raw sugar equivalent, would grow by 3.3-4.3 percent annually, to 2.06-2.19 million metric tonnes by the year 2000.

If the potential expansion in production areas materializes, then output would reach more than 32 million tonnes of cane and 2.1 million tonnes of sugar by 2000 resulting in a deficit of 300 000 tonnes. Net import requirements would thus be somewhat greater than in recent years. However, if yields and sugar recovery rates could be improved, there would be potential for renewed growth in export availabilities.

Table 1 : Philippines sugarcane area, yield and production

Year	Harvested area	Yield	Production
	'000 Ha	*Mt / Ha*	*'000 Mt*
1976	553	53	29,315
1977	514	53	27 222
1978	451	49.9	22 525
1979	483	46.7	22 552
1980	442	50.9	22 490
1981	382	60.3	23 034
1982	496	50.1	24 836
1983	464	51.9	24 063
1984	460	56.5	25 969
1985	406	46.1	18 719
1986	308	52.4	16 124
1987	269	51.1	13 752
1988	270	58	15 664
1989	300	64.6	19 375
1990	335	57.8	19 352
1991	345	59.4	20 499
1992	371	61.5	22 816
1993	376	63.7	23 968
1994	381	59.7	22 753
1995	375	49.3	18 505
1996	368	62.2	22 907

Table 2 : Philippines sugar production, trade and consumption

Year	Production	Trade		Consumption	
		Imports	Exports	Total	Per caput
		...'000 Mt, raw equivalent ...		*kg/year*	
1976	2 844	0	1 467	839	19.1
1977	2 544	0	2 444	967	21.5
1978	2 335	0	1 124	1 086	23.6
1979	2 287	0	1 150	1 158	24.5
1980	2 343	0	1 747	1 210	25.1
1981	2 395	0	1 245	1 134	22.9
1982	2 440	0	1 261	1 065	21
1983	2 458	0	973	1 205	23.1
1984	2 498	0	1 102	1 285	24.1
1985	1 731	0	583	1 341	24.5
1986	1 447	0	222	1 182	21.2
1987	1 197	28	163	1 440	25.2
1988	1 357	81	143	1 228	21.1
1989	1 814	5	213	1 472	24.7
1990	1 810	1	247	1 582	26
1991	1 736	13	275	1 529	24.6
1992	2 061	17	209	1 619	25.5
1993	2 131	13	325	1 717	26.4
1994	1 873	29	183	1 794	27
1995	1 705	377	154	1 817	26.8
1996	1 791	827	229	1 970	28.2

THAILAND

INTRODUCTION

Opportunities to supply sugar to growing markets in Asia have encouraged Thailand to expand production. With relatively small internal needs for sugar and low shipping costs, especially to growing regional markets, Thailand has become one of the world's leading exporters. The Government policy of maintaining high domestic sugar prices has fostered increased production, dampened growth in use, and increased exportable surpluses.

In recent years growth in sugar production has come largely from area expansion in the North and Northeast

regions. In the future, greater emphasis is expected to be given to the introduction of higher yielding varieties and increased use of yield-enhancing production inputs. Demand for sugar in Asian markets is expected to remain strong. The major constraint to longer term expansion could be the emergence of transportation and infrastructure bottlenecks which would impede the flow of sugar to export markets.

PRODUCTION

Following a decade and a half of sustained expansion, sugarcane areas and production increased sharply in recent years, with a record output achieved in 1996. The recent success of the industry can be attributed to several key factors, including attractive sugarcane prices, sugar factory relocation and capacity expansion policies which have successfully encouraged the extension of sugarcane areas. A third factor has been favourable weather. Since less than 10 percent of sugarcane area, now over one-million ha, is irrigated, favourable rainfall distribution has been an important factor in improved yields.

There are approximately 107 000 small holders who grow sugarcane in Thailand. Mills do not grow their own cane, but contract from growers. Sugarcane farmers in the Northeast region generally plant their cane in October and November, and in the Eastern Central Plains region, November to February. Planting in the irrigated area of the North region is December to April and May to June in the rain-fed area. In the Western Central Plains area, planting in irrigated areas is from January to March and in the rain-fed area May to June. While the sugarcane crop calendar varies by region, the growing period is about 10 to 14 months depending on the variety of cane. Farmers generally grow only one or two ratoon crops, and as a result they can change area planted relatively quickly in response to world price changes. For example, the total sugarcane area increased sharply on the heels of the global price spikes of the mid-seventies, early eighties, and since the second-half of the eighties (Table 1). The expansion reflected the relative attractiveness of sugar prices compared with alternative crops such as cassava and watermelon in the Northeast, and beans and corn in the North.

Yields of sugarcane have been gradually improving with the greater use of fertilizers and pesticides and improved cane varieties. Until the late eighties, yields were below the Asian and world averages. Expansion of irrigation is especially important as more land is put into cane in the drought-prone Northeast-region. Research to develop new improved varieties is being undertaken at Suphanburi Field Crops Research Center at U-Thong in Suphanburi province.

PROCESSING

Currently there are 46 mills in operation with an estimated daily crushing capacity of 571 190 tonnes. This compares with 42 mills at the beginning of the eighties and a capacity of 196 561 tonnes. Thailand has no stand-alone refineries, and all sugar refineries are part of cane crushing mills. As a result, raws go directly to remelt for refining, and by using power from the mill the refining costs are reduced.

Sugarcane is harvested from November to March in Thailand. During the 1996 season a record 62 million tonnes of cane were processed and 6.3 million tonnes of sugar produced (Tables 1 and 2). This represented an 8 percent increase in cane and a 13 percent increase in sugar output over the previous peak levels of 1995. These results indicated greater utilization of crushing capacity, a long-term goal of the industry.

During the eighties, the significant increase in mill capacity met the crushing requirements for expanding cane output, including harvesting peaks. However, the development of over-capacity in the Central region caused the Government to seek ways to achieve a better balance between the availability of milling capacity and the production of sugarcane. While no new licenses were issued for mill construction, a mill owner could close a mill and use the existing license to build a new plant in a different location with greater capacity. This policy encouraged some mills to relocate to the North and Northeast regions and expand facilities. These important changes in the structure of the industry were reflected in the re-distribution of output levels. In the early eighties (1982/83 to 1984/85) sugar production in the Central region averaged 1.32 million tonnes and accounted for 58 percent of the national production. By the early nineties (1992/93 to 1994/95) the Central region was producing 1.73 million tonnes, but accounted for only 41 percent of production. The Eastern region also showed a decline in share from 16 percent to 9 percent while production remained roughly the same. The regions of greatest growth were the North which increased from 13 percent to 23 percent by the early nineties, and the Northeast from 14 percent to 26 percent over the same period.

Structurally the milling and refining sector is comprised of a mix of government, independent and private ownership groups. The State owns 3 mills, and there are 15 independent mills. There are 9 groups of owners which operate 2 or more mills. The largest is the Thai Roong Ruang Group which operates 7 mills.

The Government, in addition to granting milling and export licenses, provides regulatory and planning functions for the milling sector On a year-to-year basis, the Ministry of Industry arranges production quotas for individual mills, based on the past 3-year crushing performance, and access to cane supplies.

CONSUMPTION

Thailand's domestic sugar consumption is expected to total a record 1.59 million tonnes in 1997, spurred by a growing population now estimated at 60.6 million, a thriving economy, and increased industrial use of sugar for soft drinks and other products (Table 2). This level of consumption represents an increase of almost 50 percent since 1990. Per caput consumption in 1997 is estimated at 26.2 kg, compared with 14.1 kg in the mid-eighties. Despite this growth, domestic sugar consumption as a percent of production has remained under 30 percent, relatively low for one of the world's leading producing and exporting countries.

The traditional relatively low Thai domestic sugar use also reflects the availability of locally grown, low-priced sugar substitutes such as coconut (palm) sugar, long a mainstay of the Thai diet in home cooking; and the traditionally low consumption of processed foods, especially in rural areas where about 75 percent of the population continues to reside There is also a small level of production of high fructose syrup (HFS) derived from cassava root and utilized by some segments of the soft drink industry. In addition, there is a small amount of non-nutritive sweeteners such as saccharin and aspartame used in diet soft drink products. Despite these moderating forces, sugar usage increased significantly in the eighties, and the pace of consumption growth has accelerated in the nineties as a result of the rapid modernization of the economy which has increased the demand for processed foods and beverages containing sugar.

TRADE

Thailand is now firmly established as one of the world's leading sugar exporting countries. During the first half of the nineties, sugar exports averaged 3.1 million tonnes per year, nearly double the level of exports during the first half of the eighties. This upward trend in exports has been spurred by growing regional markets, higher domestic production, low internal consumption relative to total production, and favourable export policies.

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

The composition of sugar exports includes raw, refined, and plantation white shipments. In calendar 1995, raw sugar exports amounted to 2.80 million tonnes or 74 percent of the total. For the period 1990-94, raw sugar exports averaged about 2.0 million tonnes per year, while refined and plantation white sugar exports averaged 831 000 tonnes, both well above the levels achieved in the early eighties.

Because of freight cost advantages and reliable services, sugar has become increasingly important in growing Asian regional trade. According to trade sources, sugar moves from Thailand to the major regional buyers China, Japan, the Republic of Korea, and Malaysia, with a freight advantages over Western Hemisphere sugar making it difficult for exporters from the latter region to compete.

In 1995, for example, more than two-thirds of the record 2.80 million tonnes of raw sugar exports went to Asian markets, with shipments to China, Japan, the Republic of Korea, and Malaysia, accounting for 2.44 million tonnes. Sizeable shipments are made annually to smaller markets in the region such as Sri Lanka, Vietnam, and Singapore. The largest non-Asian markets in 1995 were the former Soviet Union, Tanzania, and the United States which combined took 79 000 tonnes.

Refined and plantation white exports in 1995 totalled 1.04 million tonnes, raw value, with China, Indonesia, and the Islamic Republic of Iran accounting for 23, 34, and 12 percent of the total, respectively. Other important destinations included Vietnam, Saudi Arabia, and Sri Lanka. The Philippines has also emerged as an important market for both raw and refined sugar, reflecting its current net importer status. Trade specialists report exports of refined sugar range in quality from "bother grade refined" (equivalent to EC or US refined sugar) to sugar with color over 100 ICUMSA (International Commission for Uniform Methods of Sugar Analysis).

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

The sugarcane industry is also an important exporter of molasses. In recent years, about 50 percent of annual production has been exported. Molasses exports averaged 945 000 tonnes and earned about US $47 million annually over the 1990-95 period. Japan normally takes about one-third of total exports, and the United Kingdom and other European destinations take most of the remainder.

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

Quota A - domestic
This quota, all refined sugar, is allocated to mills by the Government at the start of each season on the basis of production capacity. The sugar is sold to approved wholesalers at a fixed price. The Quota A for 1995/96 was set at 1.6 million tonnes.

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

Quota C - exportable surplus
The mills undertake their own pricing of this sugar, but must pay growers at least the Quota B sales price achieved by the TCSC. These sales must be made by licensed exporting companies. For 1995/96 the Quota C was set at 3.3 million tonnes of raw or refined sugar.

While licenses to build new factories are not currently being issued, new quota tonnages are annually allocated to mill groups with the largest C Quota production to encourage mills to crush as much cane as possible. Mills must meet production targets for Quotas A and B, before exporting under Quota C.

Quota C (export) sales are usually concluded 6 months prior to the start of the crushing season in November by seven authorized exporting companies: The Thai Sugar Trading Corp., Ltd. (TSTC), Thailand Sugar Corp., Ltd. (TSC), Siam Sugar Export Corp., Ltd. (SSEC), the Sugar Industry Trading Co., Ltd. (SITCO), K.S.L. Export Trading (KSL), Pacific Sugar Corp., Ltd. (PSC) and TISS Co., Ltd. which belongs to the Thai Identity Sugar Group of Companies which started its sugar exports in 1995.

PRICES
The Government directly negotiates annual sugarcane prices with growers and mills. It also operates a credit programme under which farmers can borrow an amount equivalent to their advance payment for sugar delivered to mills, at below-market interest rates.

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.

This advance payment is not to be less than 80 percent of the share expected at the end of the season. If the actual

"season-average price" is lower than the base price, the difference is adjusted the following season.

The Sugar Act of 1984 also provides for a 21-member Cane and Sugar Board composed of nine growers, seven government, and five mill representatives, which controls cane production levels, encourages improvement in quality, and seeks lower production costs to make exports more competitive. One recent target set by the Board was to limit cane production to zones within 100 kilometers of a mill to lower transportation costs.

FUTURE PROSPECTS

Sugarcane production is projected to reach 82.4 million tonnes in 2005, with sugar output attaining some 8.9 million tonnes. For sugarcane, this would represent a 32 percent increase over 1996, or 3.1 percent average annual growth; and for sugar, a 41 percent increase over the 1996 output, or 3.9 percent average annual growth. Given the industry's past performance these projections do not appear unrealistic. The extension of areas under sugarcane is anticipated in the North and Northeast regions, including as a result of converting land from other crops. By 2005 the area under cane is expected to total 1.25 million ha, a 17.6 percent increase over 1996, or 1.8 percent average growth per year.

A pivotal factor in achieving production goals of the industry is the improvement of sugar yield per tonne of cane. Sugar yield depends on several factors relative to the sugarcane (harvesting and handling conditions and quality) and the sugar factory (process, operations and composition of output). Since almost all sugar factories are still affected by underutilization problems, they seek to maximize sugarcane volume, not sugar yield, to mitigate costs. This leads to strong competition for sugarcane which can worsen the quality of crushed sugarcane in terms of purity and freshness, and thus affect negatively sugar yield.

According to international sugar production cost analysts, Thailand ranks among the world's lowest cost producers. Efforts to expand cane production to better match milling capacity should enhance this status. However, in the long run Thailand's future as a very low-cost producer is not certain in view of sharply increasing land costs reflecting rapid industrialization and rising labor costs.

Domestic demand is likely to continue to expand rapidly, but growth in production should continue to allow Thailand to absorb only about 25 to 30 percent of annual output internally. Domestic use is projected to expand to 2.33 million tonnes in 2005, up 50 percent from 1996, or average annual growth of 4.6 percent per year. With stable use of coconut (palm) sugar as a sugar substitute for home cooking, increased demand for sugar would most likely come from industrial users for the manufacture of processed foods and beverages. The growth potential for increased sugar demand by the expanding soft drink industry is projected to be particularly strong in the years ahead as consumption of these beverages approaches the level of Singapore and China, Hong Kong Special Administrative Region. Nonetheless, among the world's top five exporters, only Australia and Cuba use a smaller percentage of sugar production for domestic needs. With anticipated growth in production, exports are also expected to expand substantially.

The industry has identified 3 areas for improving the management of the export sector: (1) the transportation system should be upgraded to cope with larger volumes of sugar to be transported from the sugar factories to export terminals; (2) a clearing house for bulk sugar should be established to allow swaps of sugar under fair, established settlement procedures; and (3) the bag-loading system should be modernized to cope with labour shortages.

With respect to markets, the industry is conveniently situated in proximity to expanding Asian import markets which allow shipping advantages, including prompt delivery and reduced freight rates, not available to competitors outside the region

Table 1 : Thailand sugarcane area, yield and production

Year	Harvested area	Yield	Production
	'000 Ha	*Mt / Ha*	*e*
1976	374	53.3	19 910
1977	494	52.8	26 094
1978	560	33.8	18 941
1979	504	40.8	20 561
1980	426	30.1	12 827
1981	457	43.5	19 854
1982	613	49.2	30 200
1983	577	42.3	24 407
1984	536	44.5	23 869
1985	531	47.2	25 055
1986	546	44.1	24 093
1987	520	47	24 450
1988	571	47.7	27 191
1989	660	55.6	36 668
1990	686	48.9	33 561
1991	882	52	40 661
1992	917	51.8	47 480
1993	902	40.2	39 827
1994	942	47.3	37 823
1995	957	58.9	57 974
1996	1063	58.7	62 422

Table 2 : Thailand sugar production, trade and consumption

Year	Production	Trade		Consumption	
		Imports	Exports	Total	Per caput
		...'000 Mt, raw equivalent ...		*kg/year*	
1976	1 710	0	1 124	524	12.3
1977	2 282	0	1 657	570	13.1
1978	1 624	0	1 040	603	13.5
1979	1 862	0	1 190	630	13.8
1980	1 098	85	452	540	11.6
1981	1 641	0	1 120	615	12.9
1982	2 930	0	2 216	620	12.8
1983	2 265	0	1 553	656	13.3
1984	2 349	0	1 248	725	14.4
1985	2 572	0	1 870	720	14.1
1986	2 586	0	1 985	740	14.2
1987	2 637	0	2 039	883	16.7
1988	2 704	0	1 872	891	16.5
1989	4 052	0	2 998	987	18
1990	3 506	0	2 426	1 065	19.2
1991	4 055	0	2 986	1 033	18.4
1992	5 106	0	3 869	1 181	20.8
1993	3 792	0	2 266	1 391	24.3
1994	4 009	0	2 672	1 480	25.6
1995	5 571	0	3 843	1 530	25.8
1996	6 300	0	4 500	1 550	26

VIETNAM

INTRODUCTION

The sugar industry of the Socialist Republic of Viet Nam is currently in transformation as growth in sugar consumption has outpaced domestic production, with the shortfall being met by increased imports. In the longer-term, the Government is

implementing a series of projects aimed at attaining self-sufficiency and later achieving a net exporter status. In its development plan, the Government is taking into consideration all stages in the production process; from growing the cane to processing the sugar. Key elements of the plan include: expansion in area planted to sugarcane to increase potential production capabilities, introduction of methods to improve current yields and of new higher yielding varieties, and a major investment initiative to expand the capacity of the domestic processing sector. The Government has set targets of 12.7 million tonnes of sugarcane production and 1.0 to 1.2 million tonnes of sugar production by the year 2000.

PRODUCTION

Viet Nam's domestic sugar industry is primarily based on sugarcane. The regions in the south account for 80 percent of the nation's cane production. Cane is generally grown in the drier regions of the Mekong Delta area in the south without irrigation, and of the Red River Delta area in the north. The area planted to sugarcane has been gradually expanding in recent years, from about 140 000 ha in the early nineties, to around 225 000 ha in 1995.

The Government aims to expand cane area to 250 000 ha by the year 2000, with 170 000 ha in the south and 80 000 ha in the north. This would represent an almost 100 000 ha expansion from the previous decade. Recent land use studies by the Government indicate that an additional 450 000 ha are potentially suited to sugarcane production.

Cane yields have averaged between 42 and 45 tonnes per ha in the past few years, with a 10.5 to 11.5 percent sugar content. The Government is working towards increasing yields of both sugarcane (to 60 tonnes per ha) and, sugar (to 5-6 tonnes per ha) by improving cane quality. Research is also focusing on developing early maturing varieties with high sucrose and good ratooning properties, along with a programme to introduce new varieties from Taiwan Province of China for new plantings.

Production of sugarcane averaged around 6.0 million tonnes in the early nineties, with the lowest level being in 1990 at 5.4 million tonnes and highest in 1994 at 7.5 million tonnes. The majority of farms are small-holder units, from 0.3 ha up to 1.0 ha, although there are a few larger holdings that are between 10.0 ha and 15.0 ha. It is important to note that although Government officially owns all the land in Viet Nam under their "doi moi" (reform) programme, the 1988 Land Lease Law does provide for long-term land use rights. For certain crops, mainly industrial, this can be up to 50 years. The lease law was designed to encourage farmers to invest in long-term improvements on the land and to foster and maintain future productivity, and it has recently been an encouraging factor in promoting increased foreign agricultural investment.

The recent expansion in area under cane production may be partially reflect the fact that sugarcane is becoming more competitive with other crops. For example, in the southern province of Long An, the area under sugarcane has expanded to over 11 000 ha in recent years, in direct competition with rice, groundnuts, and pineapples. And in the north-central province of Thanh Hoa, increases in sugarcane areas were taken from land formerly used for pineapples and coffee.

Vietnamese growers generally perform manually most sugarcane production operations, including harvesting. The harvest takes place between November to May. The potential for increased mechanization is another option being explored by the Government, as with expanded areas the availability of labour, especially at harvest, may become a constraint.

According to official FAO statistics, sugar output in the early nineties averaged around 411 000 tonnes and in 1995, an estimated 10.7 million tonnes of sugarcane was grown and around 517 000 tonnes of sugar was produced.

PROCESSING

Currently, the commercial milling capacity is around 13 500 tonnes per day, from 12 mills ranging in capacities from 500 to 2 000 tonnes per day. The Government is strongly promoting expansion in the sugar processing sector, as part of a nation-wide effort to expand overall food processing capacity. Sugar self-sufficiency by the year 2000 is one of the national objectives, but the larger goal is to provide growth opportunities for rural development to increase employment and enhance incomes.

About 30 percent of the sugarcane crop is normally processed by the commercial/industrial cane mills. The remaining 70 percent is processed by numerous small cottage industry plants, with capacities often under 100 tonnes per day. They are often highly inefficient, incur major losses of sucrose, and produce a lower quality of sugar. However, these mills serve a very important function in the processing industry, as they are often centrally located in the key production areas and can be easily reached by the local growers. On the contrary, large movements of cane by growers to the bigger commercial mills can be difficult and costly. In 1993/94, of the estimated 7.5 million tonnes of sugarcane harvested and 326 000 tonnes of sugar produced, these cottage industry or "handicraft" mills processed 70 percent of the total. Towards the year 2000, with the national goal of increasing sugarcane production to up to 12.0 million tonnes and sugar production up to 1.0 million tonnes, the objective is to increase the share of the commercial mills in the processing of the additional supplies, to more than 65 percent.

The Government's sugar processing expansion strategy is characterized by three broad areas: (A) expansion existing capacity, (B) construction of new large scale operations, and (C) increase in the number of small scale operations.

The first area concentrates on mill modernization and expansion of capacity at several existing mills. By the year 2000, the objective is to raise total capacity by 11 percent to 15 000 tonnes and the average mill size to 1250 tonnes . Currently, the Government owns and operates these mills. The Union of Agricultural-Industrial Enterprises of Sugarcane (VINASUGAR), an agency of the Ministry of Agriculture and Rural Development (MARD), is the administrating agency. In the south, VINASUGAR No. II operates 5 sugarcane mills and 2 sugar refineries. And, in the north, VINASUGAR No. I operates 7 sugarcane mills and 1 sugar refinery.

The second area is to expand production through the construction of new commercial processing operations, with capacities ranging from 4 000 to 8 000 tonnes per day and at a potential cost of US $11 million. This effort involves a number of joint venture projects (between Vietnamese and foreign investors) and one project funded by 100 percent foreign investment capital. The projects include:

From Europe, France's Sociétés de Bourbon (SB) is building a US $95 million sugar mill near Ho Chi Minh City, in partnership with local sugar producers (Union Des Sucreries de Tay Ninh (TANISUGAR) and VINASUGAR No. II). The new mill will be the largest in Viet Nam and is anticipated to begin production in 1997/98. In addition, the United Kingdom based Tate and Lyle Company is expected to construct a new plant in the north-central region at a cost of US $72 million.

From Asia, a number of large-scale mill projects are being undertaken by the Philippines, India, and Taiwan Province of China. A joint Vietnamese- Taiwan Province of China venture is underway in the north-central region for a plant with a daily capacity of 6 000 tonnes, and contracts have already been negotiated with local farmers for supplies. Another primarily Asian based joint venture involves Viet Nam and the Philippines, and is to be located in the north-coastal region. The mill will have an initial capacity of 4 000 tonnes per day and is expected to begin operations in 1997/98.

In a somewhat different development, an Indian based company is constructing the first wholly foreign-owned sugar plant. The mill is scheduled to begin operations in 1996/97, and will have a daily cane crushing capacity of 3 500 tonnes, which it is planned to double by the year 2000.

The third strategy area involves the building of a large number of small scale operations, with capacities in the range of 500 to 3 000 tonnes per day. This will also involve the co-operation of foreign partners and capital in supplying equipment, machinery, and the transfer of technology. There are 34 mill projects under consideration. If all the projects are undertaken, they could generate an additional 35 000 tonnes of daily mill capacity. A typical project is the new mill in the northern mountain province of Tuyen Quang. The plant began operations in early 1996 and was designed to process 750 tonnes of sugar per day and provide employment for more than 100 workers.

CONSUMPTION

Sugar consumption has been increasing in recent years and is expected to reach a record 695 000 tonnes in 1995. Consumption has been growing faster than production and this has lead to a corresponding increase in imports.

In the early nineties, per caput sugar consumption averaged around 6.9 kg, about the same level as in the previous decade. However, a distinctive consumption increase occurred in recent years with per caput consumption rising from 6.8 kg in 1993 to 8.8 kg in 1994. In 1995, per caput consumption further increased to 9.4 kg, its highest level ever. However, these figures are still well below the world average of 20 kg and that of other growing regional economies such as Thailand with 28 kg, Pakistan 22 kg, Philippines 28 kg, and Malaysia 50 kg. Consumption is expected to continue to increase in both raw form and for use in the expanding food processing industry. Current macro-economic indicators indicate a potential for expansion in sugar use, as population (currently estimated at 74 million) is growing by about 2.0 percent per year and per caput income would reflect a national annual growth rate of about 6 percent.

In the manufacturing sector, expanding production of sugar-containing products is a contributing factor in the recent consumption increases. The use of sugar-containing products is expected to intensify in the coming years, as these products become more widely available. For instance, a number of new plants are being constructed to produce confectionery and ice creams. The soft drink industry is likely to be the largest industrial user of sugar, with annual average growth estimated at 25 percent over the next few years. In 1994, per caput carbonated soft drink consumption in Viet Nam was estimated at 14 eight ounce bottles (about 3.5 litres), which is much lower than other countries. Thailand for example has a per caput rate of 112 eight-ounce bottles (about 28 litres). The leading global soft drink franchisers are all planning expansion projects in the country.

.Taking into consideration the expected growth rates for sugar by industrial users (beverages, dairy products, confectionery, bakery, fruit and food processing) and direct consumption as spurred by population growth, some analysts predict that sugar use could double in the next 5 years. This would suggest that the current supply expansion programmes are likely to just keep pace with the estimated demand growth. It also seems unlikely, because of relative cost considerations, that an alternative sweetener will become readily available to act as a damper on demand.

TRADE

A deficit sugar producer in recent years, Viet Nam has become a sizeable sugar importer. In 1994, imports reached 141 000 tonnes. This was a 76 percent increase over the 1993 level of 76 000 tonnes. In 1995, imports increased to 184 000 tonnes.

Each year, the level of imports is determined by a Government committee through the granting of licenses. In 1995, 74 000 tonnes of raw sugar and 101 000 tonnes of refined sugar were imported, at a value of between US $45 and $50 million, with corresponding duties of 25 percent on raw and 35 per cent on refined, *ad valorem*.

In previous years, Viet Nam had a long standing barter arrangement with Cuba (rice for sugar), but recently Cuba has been unable to maintain a stable supply and the presence of this origin has faded from the Vietnamese market, as has the presence of the former USSR which was another regular supplier.

In recent years, the bulk of imports have been sourced from neighbouring Asian countries. In 1994, Thailand was the most important supplier, accounting for 74 percent of total imports. In 1995, sugar was sourced from Thailand and Australia, as well as a number of other Asian countries. In December 1995, Viet Nam joined the Association of South East Asian Nations (ASEAN), which has placed ASEAN members at a price advantage to supply the Vietnamese market, relative to non-ASEAN members. This could restrict trade to within the ASEAN region, as Viet Nam is committed to lowering their duty on sugar imported from the ASEAN countries to zero by the year 2003.

In the long run, if the Government plans for increased production are realized and exceed the pace of growth in demand, then Viet Nam's import needs would naturally diminish. Recent reports for 1996 indicate that imports may total only 70 000 tonnes and could be halted in 1997 due to increased domestic capacities and a general economic policy to reduce import expenditures and improve the overall balance of trade.

PRICES

The National Price Commission sets an annual minimum price for sugarcane and a maximum price for sugar. For 1995/96, the official cane price was VND $200 000 (US $18.2) per tonne and refined sugar was VND $7 000 (US64 cents) per kg. The attractive cane price encouraged growers, as estimated costs of production were VND $140 000 (US $12.7) per tonne, and the cane mills provided production input support and a ready market for the cane.

The increased production in 1995 and 1996, combined with relatively large government stocks, has acted to put downward pressure on prices this spring. In the major cane growing provinces (such as Tay Ninh and Song Be) prices ranged from VND $150 000 (US $13.6) to VND $220 000 (US$ 20.0) per tonne, but in other provinces prices fell below VND $100 000 (US $9) per tonne. Faced with relatively low prices, some farmers in the south were reportedly considering alternative crops.

Market analysts and industry experts believe the current market problems are of a short run nature due to sugarcane cultivation capacity outpacing growth in processing capacity.

The Government's programme to expand processing capacity is a long term solution to this situation. In the short term in order to eliminate price distortions, the Ministry of Agriculture and Rural Development (MARD) has proposed several measures, including input subsidies of VND $21 billion (roughly US $1.9 million) to cane growers and low interest credit to refineries and processing plants.

At the retail level, prices have been fluctuating. In March 1995 prices in Ho Chi Minh City and Hanoi were VND $7 000 (US $0.64) and VND $7 200 (US $0.66) per kg, respectively. By March 1996 prices had fallen to VND $6 100 (US $0.46) and VND $6 500 (US $0.55) per kg. Currently, the domestic sugar prices are lower than the world price. However, the prices of sugar containing products are generally comparable with the prices in other countries. For instance, a single scoop of ice cream was VND $18 000 (US $1.65), and a 12-ounce soft drink cost between US $0.50 and 0.80. When compared to average income levels (approximately US $200 a year) these prices seem very high, but continued income growth is acting to sustain product demand.

FUTURE PROSPECTS

The sugar industry is currently undergoing a fundamental change, fostered by the Government's programme of expansion and self-sufficiency. The Government's targets plus the main strategies to be employed can be summarized as follows;

Goal:

Production of 1 to 1.2 million tonnes of sugar by year 2 000 (as compared to 450 000 tonnes in mid-nineties).

Main Measures:

1. area expansion: increase land in sugarcane to 250 000 ha (as compared to around 200 000 ha in the mid-nineties)
2. increase yields: raise yields to 60 tonnes of cane per ha (as compared to around 45 tonnes in recent years)
3. enlarge cane production volumes for processing to 11 to 12 million tonnes (as compared to around 7 to 10 million tonnes in the mid-nineties)
4. build new sugar mills and expand existing mills.

As Viet Nam pursues its sugar industry goals several issues are likely to emerge:

1. Post-harvest losses of sucrose in the cane is high, especially in areas where transportation from the fields to the mills is limited. While movement of cane by water can help to minimize this issue, especially in the Mekong River Delta, deficiencies in the rural road system continue to be a major constraint on the efficiency of the sugar industry in particular and the agricultural sector in general.
2. In several areas where sugar production is targeted for expansion, the issue of availability of rural labour for sugarcane production and harvest may act as a future constraint. Mill managers and government researchers are currently exploring prospects for encouraging increased levels of mechanization, particularly in harvesting.
3. In some areas, increased competition for cane between the "handicraft" mills and commercial mills or between the commercial mills themselves may emerge. This could cause some mills to operate below levels of optimal efficiency, and is a reflection of the process of transition from a high level of dependence on "handicraft" mills to an increased reliance on commercial facilities.
4. The role of trade will become increasingly complex, including the level and composition of imports and their origins. For instance, the impact on Viet Nam's tariff structure from its joining of ASEAN could affect access to its market from non-ASEAN countries.
5. The role of government in setting price policies will be extremely important to the achievement of its targets. The annual setting of cane prices relative to other commodities may influence planting intentions and affect planned area expansions.
6. With consumption of sugar expected to increase as the population and economy expands, the need for improvement in sugar quality will increase. This is particularly important for the food processing and soft drink industries.

A QUANTITATIVE MARKET OUTLOOK FOR SUGAR TO 2005 IN MAJOR ASIA AND PACIFIC COUNTRIES

These are preliminary projections prepared by the Sugar and Beverages Group of the Commodities and Trade Division, FAO.

INTRODUCTION

It is of particular importance for both government decision-makers and industry leaders to have a good understanding about the future direction and development of the world sugar market. Sugar is one of the most important commodities produced and traded in world agricultural markets. The industry has been expanding in production and processing over the decades. Up to 25 percent of sugar produced is physically traded in the global area. The importance of sugar has prompted many attempts at modelling the world sugar economy. The models have varied widely in their specifications and goals. For instance, some models have aggregated the world into regions, while others have chosen specific countries as representative, and certain models have concentrated on trade flows, while others have examined supply and demand or looked at price behaviour. This study represents the first phase of an FAO project to build a new global sugar model.

MODEL SPECIFICATION

The FAO model builds upon the strengths of models developed to date, but places a heightened emphasis on demand factors through the use of a habit function, i.e. where current demand is related to previous levels of consumption. In addition, the analysis was strengthened by field visits to the major producing and consuming countries in the Asia and Pacific region. Hence, the models are estimated using a richer data set which gives more reliable and consistent estimates of the elasticities. The study covers Australia, China, Fiji, India, Indonesia, Japan, Pakistan, Philippines and Thailand. As a group these countries accounted for about 40 percent of world sugar production, 30 percent of consumption, 32 percent of imports and 18 percent of global sugar exports in 1996.

CONSUMPTION

The importance of habit

To illustrate the importance of habit, we have recently examined a new extensive set of data on China where people living in the Southeast coastal region prefer sweeter foods while those in the Northern provinces like savoury foods. This is reflected in the different sugar consumption levels which have existed for a long time between northern and southern regions. This type of consistent divergence in sugar consumption levels, largely independent of income, can also be found in cross-country comparisons. Many Asian countries experienced rapid economic growth over the past decades, but the increase in per caput sugar consumption has been much less than the income growth in some of these countries. For example, in Indonesia per caput income in real terms nearly doubled during 1983-1995, but per caput sugar consumption increased only by 23 percent from 11 to 13.5 kg during the

same period. In contrast, although the real per caput income in Pakistan increased by about 30 percent from 1983 to 1995, per caput sugar consumption nearly doubled from 11 to 20 kg in the same period. Japan has the highest per caput income in Asia but its per caput sugar consumption was significantly lower than many developing countries in this region.

The habit formation model reflects past consumption patterns when forecasting consumption levels. The model is estimated for each country separately. For comparison, another model, which excludes habit formation, is also estimated for each country using the same data set. Since the factors driving demand for industrial use may differ from those affecting direct consumption, the demand for direct consumption and that for industrial use were estimated separately, when data were available. For example, in the case of India, the consumption of gur and khandsari accounts for a large share of sweetener consumption and is closely related to both sugar consumption and production. Therefore, the demand for gur and khandsari were also estimated, separately.

In general, the data fit the models well. The hypothesis that consumption habits had no impact on the demand for sugar was tested using the likelihood ratio test, and was strongly rejected in all the country models. This supports the view that habits will also play a role in the future consumption of sugar too.

The price elasticities were in the range of -0.1 to -0.45 for all countries except for Japan and India. The price elasticity in Japan was high, about -0.8 which implies that the demand for sugar was more sensitive to a change in the sugar price. The competition from the highly developed alternative sweeteners industry (HFCS) and the dominant industrial use of sugar are probably responsible for the higher sugar price elasticity. The price elasticity in India is also relatively high, -0.6 which may be attributed to the existing alternative low quality sweeteners market which would induce consumers to shift from white sugar to gur and khandsari if the sugar price increases.

It has been a widely accepted view that income was the key factor in determining future consumption levels in developing countries. As per caput sugar consumption levels were low, future sugar demand in these countries would be expected to increase rapidly with economic growth. However, the empirical analysis provided a somewhat different insight. If the habit effect was taken into account, the impact of income on sugar consumption was very small suggesting that changes in income may not influence sugar consumption a great deal, particularly in the short-run. For instance, the income elasticities for China, Indonesia and Philippines were only 0.03, 0.03 and 0.06, respectively, which suggest that the impact of changes in income is not significant short-run in these countries. The short-run income elasticities for other countries based on the habit formation model were also relatively small, ranging from 0.1 to 0.45, excepting for Pakistan, which has an income elasticity of nearly 0.9. An explanation for the relatively high income elasticity in Pakistan would be that consumer preference for sugar was high, but severely constrained by income. Thus, a change in income would induce significant changes in sugar consumption.

Another interesting finding was that the estimated income elasticity for Australia was negative implying that sugar consumption would decline as income increased. Current high per caput consumption levels and increasing health concerns would appear to be the main factors behind this observation. The industry had recently initiated a series of nutritional campaigns in Queensland to try to reverse the trend.

The income elasticity of demand for industrial sugar use was found generally to be larger than that for direct household use. For example, in China the elasticity was about 0.6 or twenty times that for direct use. The income elasticity for gur and khandsari in India was found to be negative, which suggested that the demand for these sweeteners would decline as incomes rose. Gur and khandsari are considered to be inferior goods.

The overstated income impact on sugar consumption in the past may be largely be attributed to the misspecifications of the empirical model in many analyses of the sugar demand. Comparing the habit formation model and the demand model without habit formation, it was found that income elasticities were much higher in the latter than in the habit formation model. The habit effect on sugar consumption varied from country to country. For instance, it was very strong in China but weaker in Fiji, Japan and Australia, where high per caput consumption already existed.

Projections

Under the assumption that the current policy regimes includes all trade restrictions on sugar imports and exports, and various domestic controls over sugar production and marketing would remain unchanged; the estimated demand models were used to forecast sugar consumption for each country from 1997 to 2005. The population and GNP data used for forecasting is available in the FAO "Compendium of Demographic and Macro-Economic Assumptions". It was assumed that prices will change at the same annual growth rates as experienced during the last five years. Since the model specification may have significant implications for projecting, for comparison purposes, both a habit formation and a standard model were used. Moreover, given that recent developments in sugar use and government policies toward sugar consumption vary from country to country, particular scenarios were designed for the analysis of each country.

Australia. Per caput consumption has been declining steadily over the past two decades. Per caput consumption was about 57 kg in 1976, 50 kg in 1986 and 47 kg in 1991. The decline in per caput sugar consumption reflects changes in consumer preference, due to health concerns, and increasing competition from other sweeteners. Sugar consumption has recovered somewhat since 1992 because of the deregulation of the sugar refining industry, which increased price competition among domestic refiners, and the sugar nutrition campaign. The FAO model projects a decline in per caput consumption in the next few years, given a very high current consumption level and a negative income effect. It is projected that per caput consumption may be about 49 kg by 2005, about 4 percent lower than the current consumption level of 51 kg. However, total consumption may increase by about 5 percent by 2005, as compared with 1996, due to an increase in population.

China. Per caput direct sugar consumption is projected to grow in the future at a slower rate than in the past, reaching 2.9 kg by 2005, while the increase in industrial sugar use is projected to reach about 5 kg per person by 2005, 43 percent above the current level. Total sugar consumption is projected to increase significantly in the next decade to reach nearly 11 million tonnes by 2005, about 50 percent higher than the actual 1996 consumption level. As other sweeteners, especially saccharin, are important substitutes for sugar for industrial use and about 6 000 tonnes of saccharin which are equivalent to about 2.5 to 3.0 million tonnes of refined sugar have been used in recent years, an alternative scenario has been designed to investigate the impact of changes in saccharin prices on sugar consumption. It was found that if the price of saccharin increased by 15 percent annually (the annual increase in the saccharin price was only about 5 percent over the last five years) but the sugar price remained unchanged at the current level, the industrial demand for sweeteners would shift from saccharin to sugar. If this happened, sugar demand for

industrial use would reach 10.7 million tonnes by 2005, about 160 percent higher than the current level and total sugar consumption would amount to 14.8 million tonnes by 2005.

For comparison, the general sugar demand model which results in a much higher income elasticity than the habit formation model was used to forecast consumption in scenario 3. It was found that total sugar consumption would reach 15.6 million tonnes by 2005, about 100 percent more than the actual national consumption in 1996 and about 43 percent higher than the projected consumption based on the habit formation model. The substantially higher consumption projection was mainly due to the dominant income effect estimated from the general model.

Fiji. It is expected that per caput sugar consumption would grow at a very slow pace. By 2005, per caput consumption would be about 43 kg, about 7 percent higher than the current level, which is consistent with the development of actual sugar consumption over the past few years. As per caput sugar consumption has already reached a very high level, amounting to about 40 kg in 1996, any further increase in consumption would be diminutive. Since habit formation had little effect on the demand for sugar, the projected sugar consumption from the tow models are nearly equivalent.

India. Per caput sugar consumption has been increasing at a relatively slow rate over the past decade. It was slightly more than 14 kg in 1996, about 18 percent higher than the 1987 level. The slow growth rate was largely attributed to the low industrial demand for sugar, a large quantity of low priced alternative sweeteners (gur and khandsari) consumed and tight control over sugar marketing , distribution and retailing by the government. It is projected that the per caput sugar consumption will increase at a slightly faster rate in the next decade as the industrial demand for sugar picks up and economic reforms give markets a greater role. Under the assumption that the annual income growth rate is 4.4 percent, it is projected that per caput sugar consumption in India would reach about 18 kg by 2005, about 25 percent higher than the current level. At the same time, per caput consumption of gur and khandsari will decline slightly during the same period. Total sugar consumption will be around 20 million tonnes by 2005, about 50 percent more than in 1995.

When habit formation was excluded, the projected per caput consumption was about 21 kg by 2005, which was 21 percent more than that projected quantity using the habit formation model. Correspondingly, the total consumption would be 23 million tonnes by 2005, about 15 percent higher than that based on the habit formation model.

Indonesia. During the past decade, per caput sugar consumption rose from 11 kg in 1985 to 14 kg in 1996, while per caput income more than doubled. Projections based on the habit formation model suggested that this relative slow growth trend would continue. It is projected that per caput sugar consumption would increase over the next decade to reach 16.5 kg by 2005, about 17 percent higher than in 1996. Total consumption would be around 3.5 million tonnes by 2005.

When habit formation is excluded, per caput sugar consumption is projected to increase substantially. It would reach more than 24 kg by 2005, about 70 percent higher than the actual consumption level in 1996 and nearly 50 percent higher than projected consumption based on the habit formation model.

Japan. The increasing use of alternative natural sweeteners, in particular low-calorie sweeteners which are preferred by consumers has resulted in the decline in sugar consumption over the past decade. The projections suggest that this trend would continue but at a much slower rate because of the higher marginal cost of increasing production of alternative sweeteners. It is projected that per caput sugar consumption would be 18.5 kg by 2000 and 17.8 kg by 2005 if the current price structure remained unchanged. Thus, total sugar consumption would be 2.34 and 2.26 million tonnes by 2000 and 2005, respectively.

Excluding habit from the model does not affect the result industrial use accounts for most of the sugar consumption in Japan.

Pakistan. Per caput sugar consumption has increased significantly in recent decades with economic development. If the trend continued, it is projected that per caput consumption would be above 28 kg, and total consumption would reach 5.2 million tonnes by 2005. Excluding habit formation it was projected that per caput and total consumption would reach 35 kg and 6.8 million tonnes respectively by 2005.

Philippines. It is projected that the increasing trend of sugar consumption would continue with its high economic growth rate. The projected per caput and total consumption would be about 35 kg and 3 million tonnes respectively by 2005. While per caput consumption would be about 30 percent more than that in 1996, total consumption would be 50 percent higher, due to the increase in population.

Comparing these projections using the model without habit formation gave a projected per caput consumption at 43 kg or about 50 percent higher than the current level by 2005.

Thailand. Economic growth and the expansion of pharmaceutical, soft drinks and bakery industries have significantly contributed to the increase in sugar consumption over the past decades. Under the habit formation model the growth of sugar consumption is projected to remain strong during the next decade. Per caput sugar consumption would rise by about 35 percent over the 1996 level to reach 35 kg by 2005. Correspondingly, total consumption would rise to 2.3 million tonnes from the 1996 level of about 1.6 million tonnes.

By contrast, excluding habit formation, per caput consumption would be 10 percent higher than the habit formation model, amounting to 39 kg by 2005.

PRODUCTION

The dynamic supply model for sugarcane and sugarbeet

Separate area yield equations derived from a dynamic sugar supply model have been estimated for each country (the details of model derivations and specifications are summarized in Appendix B). Since the factors affecting production decisions of producers vary from country to country, the general specifications for area and yield have been modified to reflect different policy regimes and production practices in these countries. For instance, to capture the impact of the liberalization of the entire sugar industry in China in 1992, a special variable was introduced in the sugarcane and sugar beet equations of that country. Similarly, since the sugar industry in the Philippines experienced significant changes during the early-eighties, a special variable was included in the area equation to take account of the consequence of these changes.

Other important policy instruments used by governments to manage sugar production were also taken into account in the model specification and estimation. For example, government purchase prices were used as the farmer-received prices for sugarcane and sugarbeet production in China before 1992 when all sugar processing factories were run by the central government (Ministry of Light Industry), but the free market

prices of sugar (crops) were used after 1992. As growers in India would receive either the government minimum price or state purchasing price each year depending on the market situation, a selection procedure was used to construct the farmer received prices by comparing the government minimum price and the state purchasing-price. The switch regression method was used to estimate the model. The expansion of the sugar industry in Australia was regulated by government before 1992 but the assigned planting areas were never binding because the actual planting areas were far below the assigned areas. Thus, the model does not directly take account of the area assignment policy but only the impact of the 1992 deregulation by including a policy change dummy variable. Moreover, when a country produces both sugarcane and sugarbeet, the area and yield equations for these two crops were separately estimated because they were produced in different regions and in competition with different crops.

Data and estimation

A sugar production data set collected mainly from national statistics was used to estimate both area and yield equations. In addition to price data, including prices of sugarcane and competing crops and various input prices, a weather variable was constructed and used in estimating the yield equation for each country because a large proportion of production was in areas vulnerable to weather conditions. The weather variable was constructed based on FAO weather data sets which contain monthly average temperature, rainfall and other indicators from the records of the major national meteorological stations. Since precipitation had an important effect on sugar yield (both quantity and quality), the deviation of precipitation from the historic average in the major producing regions during the planting and growing periods was constructed as the proxy for weather conditions. When such detailed precipitation data was not available, a weather dummy was included based on country reports about the weather impact on sugar crops - good, bad or normal. As technology has played an important role in sugar production, a time trend was included in the yield equation as a proxy for technical change.

Empirical results

In general, the data fit the model well except for the yield equation for a few countries, for example, Fiji. In general, the production responses to prices in the short run were not very strong, ranging from 0.2 to 0.4 for most countries, which may reflect the difficulties facing sugar farmers in changing their production decisions, given the existing institutional and economic constraints. In particular, the supply elasticity in India was estimated to be only about 0.01 which suggested that the change in price had little impact on production. The substitute price elasticities of other crops for sugar crops ranged from -0.1 to -0.3. The extremely low substitute price elasticity in Fiji and Indonesia, only -0.01 may reflect fewer production alternatives and difficulties to shift from sugar to other crops facing sugarcane farmers in the short run.

The estimated results from yield equations suggested that technical progress had played an important role in the yield levels as the coefficient associated with the technical change variables in the yield equations for most countries were statistically significant. The changes in farm input prices were also found to affect yield levels. However, when weather had the dominant effect on the yield level, the effect of changes in input prices on yield became statistically insignificant.

Projections

The estimated equations were used to project sugar production for each country. The basic assumptions for conducting forecasts were unchanged - policy regimes, normal weather, and the same growth rates for all prices as the average annual rates over the last five years. It was also assumed that the conversion ratio from sugarcane or sugarbeet to raw sugar would be the same as the average rate for the last five years. Since a certain proportion of sugarcane was also consumed in other fora or used to produce other types of sweeteners, for example gur and khandsari in India, this assumption implied that the structure of sugarcane use would remain the same as that during the last five years. To analyze how the changes in government policy would affect sugar production, various different scenarios **we**re also designed for the countries concerned for the model simulations.

Australia. High productivity and cost efficiency from large scale operation have contributed and would continue to contribute to the expansion of sugar production in the next decade. The deregulation of the sugar industry since 1991 had also been given the industry greater impetus to compete with exporting countries in the world market. It is projected that planting area and yields would increase by more than 20 percent, from 400 000 ha in 1996 to 490 000 by 2005. Yields are expected to increase by about 10 percent, from 100 tonnes in 1996 to 110 tonnes by 2005. Both the expansion in area and increase in yields would result in higher sugar production. It is projected that sugar production would reach 6.6 million tonnes by 2000 and 7.5 million tonnes by 2005. As sugar production is largely driven by world market price, it was found that the total production would reach 8.6 million tonnes by 2005 if the world sugar price increased by a 5 percent annual rate rather than 3.7 percent assumed in the base projections. This fact suggested an expansion potential and sensitivity to the world market price of the sugar industry in Australia.

China. Production has been volatile over the past few years. Although climate and other social-economic factors have an important impact on production, government policies toward sugar and other agricultural commodities also have a profound impact on annual production levels. Since the government still controls prices of grains, the major crops competing with sugar, changes in grains prices would induce a reallocation of resources, especially land, between sugar and grain crops. To analyze how the government policy will affect future sugar production, three different policy scenarios were designed: (a) no changes in the relative price relationship between sugar crops and other competing crops; (b) 5 percent higher prices per annum for grains; and (c) 5 percent lower prices for grains per annum.

Projections indicated that the production of sugar crops were very sensitive to changes in relative prices. Both sugarcane and sugarbeet planted areas would decline from current levels in scenarios (1) and (2). The sugarcane areas would be about 24 and 63 percent lower, respectively for scenarios (1) and (2) than the 1996 level by 2005, while the sugarbeet area would decline by about 30 and 50 percent by 2005 compared with the 1996 level. However, if the annual growth rate of grains prices was 5 percent lower than their average over the last five years, both sugarcane and sugarbeet area would increase to reach 1.4 million ha and 0.8 million ha by 2005, about 29 percent and 14 percent higher, respectively, than the current levels, because the decline in grains prices would make it relatively profitable to produce sugar crops.

Yields of both sugarcane and sugarbeet are expected to continue their increasing trends. It is projected that sugarcane and sugarbeet yield would increase by 25 percent and 33 percent, respectively by 2005, compared to their current levels. As the projected area differed greatly among the three different scenarios, the projected sugar production levels also varied with these scenarios. If the current policy regime remained unchanged (scenario 1**)**, the total sugar output would amount to 6.6 million tonnes by 2005, about the same as the average level for 1993 to 1996 as the impact of the decline in area would largely be offset by increases in yield. If the government carried out a price policy which favoured the grain

sector (scenario 2), sugar output would only be about 3.6 million tonnes by 2005, about half the present level. In contrast, sugar output could reach 8.4 million tonnes by 2000 and 11.3 million tonnes by 2005 if the government's grains purchase prices (support prices) were 5 percent lower annually (scenario 3). These simulation results reveal the prominent role of prices in the future development of the sugar industry in China.

Fiji. The decline in yields of sugarcane over the past decade has been attributed to two major factors. As the continuing expansion of planted area pushed production into marginal land, low soil fertility and difficult undulating terrain resulted in lower yields. Moreover, a large proportion of sugarcane farmers operate on a very small scale leading to inefficient production and lower yields. It is expected that given current policies, the downward trend in yields would persist as the expansion in area continued. It is projected that the planted area would expand to about 98 000 ha by 2005, about 19 percent more than the current level while average yields would decline by about 8 percent to 48 tonnes per ha by 2005. Sugar production, however, is expected to increase by about 13 percent from the current level to 0.6 million tonnes by 2005. Given the great potential to increase yield through better farming practice, total sugar production would reach 0.6 million tonnes or higher by 2005 without any expansion of area.

India. Both the increase in yields and expansion of sugarcane areas have contributed to the significant increase in sugarcane production over the past decade. The sugarcane output in 1996 was about 50 percent more than in 1986. Based on the forecast made, this trend would continue. It is projected that sugarcane yields and planting areas would reach 79 tonnes per ha and 4.46 million ha respectively by 2005, a 40 percent increase in sugarcane production. Sugarcane has been used for producing both sugar and low quality sweeteners such as gur and khandsari. To project sugar production, it is assumed that production of gur and khandsari would always be equal to their projected consumption levels. Therefore, sugar production could be derived from the residual of the total output, deducting the amount of sugarcane used to produce gur and khandsari. It is projected that the total sugar production would be 19 million tonnes by 2005. An increase in the use of fertiliser would bring about higher yields and hence, the total production level. Given that the projected planting areas would remain unchanged, it was found that the total sugar production would reach 20 million tonnes if there would be a 5 percent decline in the price of fertilizer annually, and a 2 percent increase in sugarcane conversion rate due to quality improvement.

Indonesia. The expansion of planted area has contributed largely to the increase in sugarcane production over the past decades. The current analysis predicts a continuing area expansion in the next few years. It is projected that the total sugarcane areas would increase from 400 000 ha in 1996 to 490 000 ha by 2005 while sugarcane yields would reach 78 tonnes per ha. As both area and yields would increase, it is projected that the total sugarcane production would reach 3.1 million tonnes by 2005. As an alternative scenario, it is projected that yields would be 82 tonnes per ha by 2005 if the fertilizer price would be reduced by 5 percent annually stimulating greater use by farmers. As a result, the total sugar output will reach 3.9 million tonnes by 2005, about 62 percent higher than the 1996 level.

Japan. Both the decline in demand for sugar and the deterioration of the relative prices of sugar crops compared to alternative crops have contributed to the area reduction of sugar crops in the past decade. It is projected that the downward trend, particularly for sugarcane production, would continue if the current policy regime remained unchanged. The forecast sugarcane area would be 17 000 ha by 2005 which is about 29 percent less than 24 000 ha in 1996. The sugarbeet area would remain at the current level, 72 000 ha by 2005. Yields are projected to decline for sugarcane but increase for sugarbeet by 2005. Consequently, the total sugar production is projected to be about 0.9 million tonnes by 2005 which is roughly the same as in 1996. However, if the prices of substitute crops declined by 5 percent annually, it is projected that the sugarcane area would only be slightly lower than the current level by 2005, while the sugarbeet area would increase by about 7 percent to reach 76 000 ha. Consequently, total sugar production would reach about 1 million tonnes, about 2 percent higher than the current level.

Pakistan. It is projected that the steady expansion in sugarcane area and the increase in yields experienced over past decades would continue, but at a slower rate given agronomic constraints. It is projected that sugarcane areas would be slightly higher, about 4 percent, than the 1996 level by 2005, to reach 1 million ha, while yields would be 19 percent higher than current levels, at 56 tonnes per ha by 2005. The sugarbeet area and yields are projected to be 9 400 ha and 31 tonnes per ha by 2005, about 17 percent and 8 percent higher respectively than the 1996 level. Total sugar production is projected to reach 3.9 million tonnes by 2005, about 30 percent higher than the 1994 to 1996 average output level.

Philippines. Although both sugarcane yields and planted areas are still below their historical highs, the sugar industry has recovered somewhat in recent years. It is projected that this recovery would continue, although at a slower rate. The sugarcane area would reach 430 000 ha by 2005, about 17 percent more than in 1996. Meanwhile, compared to 1996, yields would increase by 21 percent to 86 tonnes per ha by 2005. Total sugar production, therefore, would amount to 2.4 million tonnes by 2005 which is 36 percent higher than in 1996 but almost the same as the level of the early-eighties.

Thailand. Production is expected to continue to increase, although less rapidly than in the past. It is projected that the total sugarcane areas would reach 1.25 million ha by 2005, about 24 percent more than in 1996. Compared with the increase in the last decade, which witnessed the doubling of sugarcane areas, this growth rate would be relatively low. The slower growth in the next decade would largely be attributed to the increasing competition from alternative crops, and lower productivity of marginal land used for sugarcane production. It is projected that yields would increase at a slower rate, from 59 tonnes in 1996 to 66 tonnes per ha by 2005 because of some of the reasons mentioned above. Although both planted areas and yields would increase at a slower pace, sugar production would reach some 9 million tonnes by 2005, more than 40 percent higher than in 1996.

IMPLICATIONS FOR CONSUMPTION AND TRADE

The future growth prospects of sugar consumption

It is widely believed that the growth in income would be the major driving force to the increase in sugar consumption in developing countries. Since most developing countries in the Asia and Pacific region are experiencing dynamic and rapid economic growths, demand for sugar is expected to increase substantially in these countries. Moreover, given the huge population base (accounting for more than half of the world's population), any significant increase in consumption in these countries would have important implications for the world sugar market. However, the analyses suggest that, for most of these countries, sugar consumption is largely driven by habit rather than by income alone. Therefore, even if income increases substantially in these countries, sugar consumption may not experience significant increases in the short run.

Trade

If no changes to stocks is assumed, the net trade in sugar for these countries can be estimated based on our production and consumption projections.

Australia. Given its competitive edge in the world market, Australia would continue to be probably the world's leading exporter. Since no significant increase in domestic consumption is expected, the increase in production would result in the increase in export availabilities. It is projected that its total export availability could reach 6.5 million tonnes by 2005, about 60 percent more than in 1995.

China. The simulation suggests that China would continue to be a sugar importer in the next decade. However, the magnitude of its imports, ranging from 4 million tonnes to 9 million tonnes by 2005, would depend significantly on government policies to both sugar and other crops. For instance, if the current policy regime remains unchanged, sugar imports could increase from about 1.2 million tonnes in 1997 to 4.4 million tonnes by 2005 because supplies would not rise while the demand increases. If the government decides to reduce the use of artificial sweeteners, in particular saccharin, this would result in a substantial increase in the industrial use of sugar. As a result, total sugar imports could then reach about 9 million tonnes by 2005. The only way that China could achieve self-sufficiency would be if the government implements a favourable pricing policy for sugar crops vis-à-vis grain. It is projected that China could have a small surplus, about 0.3 million tonnes by 2005 if the government policy stimulated a significant expansion of both sugarcane and sugarbeet production at the expense of other crops.

Fiji. Given its stable consumption level, Fiji would continue to be a medium-sized exporter in the world sugar market in the next decade. Total exports could reach 580 000 tonnes by 2005, about 12 percent higher than the current level.

India. Although it is the world largest sugar producing country, India has only occasionally been a significant sugar exporter over the past decades as most its output has been consumed domestically. This situation would continue into the next decade. Domestic demand for sugar would increase substantially because of its population growth and the increase in per caput consumption. If additional efforts were made to increase production from now, India would meet its domestic sugar demand. However, if it did not, then it would need to import sugar by the year 2000, and total shipments would reach 1.7 million tonnes by 2005.

Indonesia. Although production is expected to increase, Indonesia would continue to be an importer in the next decade because the growth in population would continue to drive up national sugar consumption. It is estimated that Indonesia would import around 500 000 tonnes annually by 2005. If its per caput consumption increased at a slightly faster pace, imports could reach more than 1 million tonnes by 2005.

Japan. It is projected that as the decline in consumption would outweigh the slight decline in production, the import level would decline marginally over time to about 1.4 million tonnes by 2005.

Pakistan. It is expected that Pakistan would continue to be a sugar importing country. It is projected that imports would reach 1.4 million tonnes by 2005 if the growth in consumption continued at its current pace.

Philippines. The future position of the Philippines in the world sugar market depends largely on government polices toward the sugar industry. If the current policy regime remained unchanged, it is projected that the Philippines could become a net sugar importing country. The quantity imported could increase gradually to reach about 600 000 tonnes by 2005.

Thailand. With the continued expansion in area under sugarcane and improvement in yields, Thailand would continue to be one of the largest sugar exporting countries in the world. It is projected that Thailand would export about 6.6 million tonnes of sugar even though its own per caput consumption could reach 35 kg by 2005. Favourable agronomic conditions and lower production costs would enhance its position as a large exporter.

CONCLUSIONS

This study estimates the demand and supply functions using the theoretically consistent models for selected Asia and Pacific countries. The empirical evidence from this study suggest that in addition to the prices and various factors, the habit of consumers has significant impact on sugar consumption. Indeed, income was identified to have a rather weak effect on the change in sugar consumption in the short run if the habit formation impact were ignored.

However, it should be noted that in preparing projections, some assumptions, such as the same policy regimes and normal weather conditions, had to be made. Therefore, if there were substantial changes in policies or variations in the weather, production and consumption from these projections would deviate.

IMPACTS OF TRADE LIBERALIZATION ON THE WORLD SUGAR MARKET

This document was prepared by the Economic Research Service (ERS) of USDA for the Sugar and Beverages Group, Commodities and Trade Division. Tables have been left out due to space limitation.

INTRODUCTION

Sugar is an important commodity in the world agricultural market with a annual average production of 120.1 million tons, consumption of 118.1 million tons, and a world trade equal to 28 percent of production for the period from 1994 through 1996 (USDA, 1997). Sugar is produced under a broad range of climatic conditions in some 120 countries and is one of the most heavily traded agricultural commodities. Like the international trade of other major agricultural commodities, sugar trade has several distinguished characteristics that include heavy government intervention, large price fluctuation, widespread production in many parts of the world, and a growing market for sugar substitutes. These features make the world sugar market a vital target for policy analysis, although they also pose considerable modelling difficulties.

Sugar is produced from sugarcane and sugarbeet. Sugarcane is mostly grown in tropical and sub-tropical regions and sugarbeet predominantly grown in temperate regions. So that sugar is produced in many parts of the world. However, sugarcane accounts for approximately 60 percent of total production of centrifugal sugar which contributes basically all of international trade. In general, many sugar producing countries, except the United States and Australia, are developing countries and cost of sugar production appears to be relatively lower in the low-income than in the high-income countries (Devadoss and Kropf, 1996). More importantly, those developing countries export and compete directly in the world sugar market. As a result, the developed countries such as the United States, Japan, Canada, and European Union (EU) heavily subsidized sugar crop producers, often at the expense of domestic consumers. The total costs to consumers, according to previous studies (Borrell and Duncan 1993, Roberts and

Whish-Wilson 1991, and Sturgiss, Tobler, and Connell, 1988), surpassed 2 billions of dollars annually in those countries.

Sugar policies, for instance government intervention by developed countries, induced significant loss on low-income sugar exporting countries as they exporters experienced lower world prices and likely lower production and reduction in employment opportunities (Devadoss and Kropf, 1996). Several previous research studies also concluded that developed countries' sugar policies have made sugar markets among the most distorted of all agricultural commodity markets and have caused significant global economic welfare losses (Marks and Maskus, 1993). However, the trade liberalization called by the Uruguay Round (UR) of the General Agreement on Tariffs and Trade (GATT)/the World Trade Organization (WTO) should lead to an improved world resource allocation by shifting sugar production to more efficient areas. Other regional trade liberalization agreements currently under discussions among APEC and ASEAN member countries of which many are important sugar traders also will provide significant impacts on world sugar production, consumption and trade. As UR policy provisions are implemented and APEC and ASEAN trade liberalization policies are carried out, it is important to sugar exporting and importing countries to assess the effects of these trade reforms on their sugar markets.

The objective of this study is to use a Computable General Equilibrium (CGE) framework that includes a majority of the sugar producing and trading countries to quantify the effects of the trade liberalization agreements negotiated under the UR on sugar production, consumption, trade, and prices of the major sugar exporting and importing countries. This study further assumes that if only APEC or ASEAN member countries liberalize their sugar related policies, or even a complete world trade liberalization, how each of the changes would affect the world sugar production, consumption, and trade. This study is different from other studies, because the CGE framework employed in this analysis allows us to evaluate the impacts not only among different countries, but also intra-sectoral effects among different sectors, including non-agricultural, or industrial and service sectors. The results of these trade liberalization analyses will be useful to sugar producers, consumers, trading companies, and government policymakers.

MODEL SPECIFICATION

The CGE model used in this analysis is constructed around a 13-region, 13-sector Social Accounting Matrix (SAM) estimated for 1992 based on the Global Trade Analysis Project (GTAP) database (Hertel, 1997). Details of this type of multi-region SAM and its construction from the GTAP Database are described in Wang (1994). The 13 regions are: (1) the United States and Canada (USA/CAN), (2) European Union (EU) (15 member countries), (3) Australia and New Zealand (AUS/NZL), (4) Japan, (5) China (including China, Hong Kong Special Administrative Region), (6) India, (7) Indonesia, (8) the Philippines, (9) Thailand, (10) Malaysia and Singapore (MYS/SGP), (11) Brazil, (12) Former USSR and Central Europe Associates (Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia, and Slovenia) (ESU), and (13) Rest of the World (ROW). The 13 sectors include 4 agricultural sectors: (1) grain, (2) sugarcane and sugarbeet, (3) other non-grain crops, and (4) rest of agriculture; 3 food processing sectors: (5) sugar processing, (6) beverage and tobacco, and (7) other processed food; 1 natural resource sector: (8) minerals and energy; 4 manufacturing sectors: (9) textiles and wearing apparel, (10) other light manufactures, (11) manufactured intermediates, and (12) machinery and transportation equipment; and, finally, (13) transportation, construction, and services, a portion of which is allocated to international shipping. There are no sugar crops sector and sugar processing sector in the version 3 of the GTAP database. The two sectors are aggregated in the "non-grain crops" and "other food processing" in the GTAP database. So, detailed data on sugar crops and sugar processing sectors have been collected to split the two GTAP sectors. The separation work and the correspondence between the model and GTAP sectors are given in appendix and appendix tables.

Factor Endowments and Comparative Advantage Across Regions

i) Production Resources Unevenly Distributed Across the World -- The four high income regions (USA/CAN, Japan, EU, and AUS/NZL) account for only 16 percent of the global labor force, but possess more than 75 percent of the world capital stock. In contrast, around half of the global labor force with less than 4 percent of the world's capital resides in the five low-income Asian developing regions (China, India, Indonesia, the Philippines, and Thailand). The four high-income regions are also relatively abundant in skilled-labor and arable land, while the skilled-labor share of the total labor force and arable land as a percent of total land mass are much smaller in China, ASEAN, and India.

ii) Wide Differences in Factor Intensities and Costs Among Regions -- Because of the uneven distribution of factor endowments, low-income developing countries have the lowest capital intensity (capital stock per worker), the largest shares of unskilled labor in their total labor force, and the highest rental-wage ratios. The reverse is true for the four high-income regions. In terms of natural resources, Japan and China are poorly endowed with arable land relative to labor. Therefore, they have the lowest land/labor intensities (arable land per worker) and relatively higher land returns (relative to labor and capital) compared with other regions. This condition is just the opposite in North America and AUS/NZL, where land as an abundant factor earns a relatively lower return there. These endowment differences are quite important for understanding net trade flows across regions based on conventional trade theory.

iii) Different Net Trade Patterns -- Sectoral net trade by region in the 1992 base year show that among the industrial countries, labor-intensive manufactured goods and mineral products are the major net imports, while capital and skill-intensive manufactured are the major net export sectors (except for machinery and equipment in the U.S. and Canada because of its deficit with Japan).

iv) Domestic Tax Policy and Import Protection -- Most general equilibrium analysis of regional economic liberalization focuses on the removal of ad valorem tariff equivalents on imports. The pattern and level of protection are very important in determining the impacts of trade liberalization. The larger the initial distortion, the greater the induced impact from an assumed policy change. For this analysis, the impact of APEC and ASEAN trade liberalization depends on the structure of the trade barriers in the estimated multi-regional SAM. The initial sectoral import protection rates as percentage of f.o.b. value, along with sectoral tax rates include the tariff equivalents of non-tariff barriers for agricultural and food products, quota rent of the Multi Fiber Arrangement (MFA) on textiles and apparel in most developing regions, and anti-dumping duties for the United States, Canada, and the EU (Hertel, 1997).

The domestic protection and export tax equivalent rates indicate that most regions in the model subsidize agriculture. Only MYS/SGP, the Philippines, China, and ESU still tax agricultural production.

Global Sugar Market - Production, Trade, and Government Intervention

Production --Climate and geographic conditions are determining factors for production of sugarcane and sugarbeet. ROW, EU, India, and Brazil are important producers of sugarcane and sugarbeet. The four countries and regions produces 68 percent of sugarcane and sugarbeet of the world. Their regional output shares of sugar crops sector and sugar processing sector are quite similar. ROW, EU, India, Brazil, and ESU are also important producers of sugar processing goods.

Trade -- It is apparent that MYS/SGP is the typical outward, while India is the typical inward economy in sugar processing sector. Thailand and AUS/NZL are more export oriented, and Japan, ESU, North America and EU are highly dependent on the supply of the world sugar market.

In the world sugar market (referring to sugar processing sector only), Thailand, EU, Brazil, and AUS/NZL are main net exporters, while ESU, North America, Japan, MYS/SGP, Indonesia, and China are net importers. The Philippines, India, and ROW are also net exporters but their size of net exports is very small. ROW and ESU are two largest importers in the world sugar market, their shares of imports in the world market are 34 percent and 21 percent, respectively. EU and North America are also significant importers. On the other hand, ROW is the largest exporter, providing 38 percent of world exports of sugar processing goods. Although Thailand accounts for only 2.4 percent of world sugar processing goods, its share in world sugar exports is 9.2 percent. In addition, Brazil and EU also play important roles in world sugar export market.

EU, ESU, and North America are the main destinations for sugar exports from ROW. ROW and ESU import most of their sugar from EU, Brazil, China, and India. APEC area is a major market of the sugar exports of AUS/NZL and the Philippines. As to the sugar imports, 95 percent of imports in EU, 60 percent in North America are from ROW. EU and ROW are main exporters of sugar to ESU market and APEC area is the supplier for Indonesia and MYS/SGP.

Government Intervention -- There is substantial government intervention in world sugar markets. Almost all the developed and developing countries protect their domestic sugar production. Typically, the import protection rate (tariff equivalent) in Japan is 372 percent. The import protection rates are around 100 percent in developing countries. There are also government subsidies on production and exports of sugar in some regions. All these policies heavily distorts the global sugar market.

All the structural information discussed above will have important implications for understanding the impact of regional trade arrangements on the world sugar market and Asian economies. However, this information cannot be considered in isolation, since changes in trade policies and protection levels in any of the regions and sectors will have impacts on other regions and sectors. It is on this point that application of a CGE model which includes all major regions in the world can make a significant contribution to understanding the possible impacts of regional trade arrangements on the world sugar market and Asian economies. The purposes of the above SAM-based analysis is to provide insights to facilitate understanding of simulation results reported later in this paper.

Structure of the Model

The model used in this paper is developed by Wang (1997) and is an extension of de Melo and David Tarr's basic general equilibrium trade model (1992) to a multi-country setting. In the extension, Wang followed John Whalley's tradition (1985) to endogenize all regions including the rest of the world, and incorporated the macro economic specifications from Devarrajan, Lewis, and Robinson (1990), as well as the international shipping sector similar to the GTAP model (Hertel, 1997). Moreover, the up-level Leontief technology in de Melo and Tarr's model was replaced by CES function, which allows substitution between value-added and aggregate inputs in the upper-level of the production tree, and their ELS demand system has been extended to ELES system, thus household saving decisions become endogenous in the model. Because duality approaches are used throughout the specification, the model is relatively simple and transparent in structure. A detailed algebraic description and a complete equation list of the model can be found in Wang and Schuh (forthcoming article entitled "The Impact of Economic Integration Among Taiwan Province of China, China, Hong Kong Special Administrative Region, and China: A CGE Analysis). The model is implemented by General Algebraic Modelling System (GAMS, Brooke, et.al. 1988).

In this study, 13 region and 13 production sectors in each region are specified in the model to represent the world economy. Each region is assumed to have basically the same structure. Four primary factors of production are modelled: agricultural land, capital, unskilled labor, and skilled labor. The division between skilled and unskilled labor is a distinction between professional workers and production workers. Primary factors are assumed to be mobile across sectors, but immobile across regions.

Economic Agents and Factor Endowments -- Three demand-side agents are assumed for each region: a private household, a public household (government), and an investor. Factor endowments are assumed to be owned by households and are set exogenously. Private households are assumed to sell the two categories of labor and to rent capital to firms, and to allocate their income from factor returns to savings and expenditures, which buy final consumption goods from the firms. The investor simply collects savings from households, government, and firms, accounting for foreign capital inflows or outflows. Total regional savings is available to the investor as his budget to buy capital goods, which are assumed to consist of fixed proportion of the 13 composite goods for gross investment.

Production -- There is a competitive firm in each sector for every region. The production is characterized by two-level nesting of constant elasticity of substitution (CES) functions. At the first level, firms are assumed to use two types of inputs: a composite primary factor and an aggregate intermediate input according to a CES cost function. At the second level, the split of intermediate demand is assumed to follow Leontief specification, therefore, there is no substitution among intermediate inputs. The four primary factors also substitute smoothly through a CES cost function. The degree of substitutability between the composite primary factor and the aggregate intermediate as well as among the four primary factors depends on their base year share in production and on the elasticity of substitution that is assumed to be constant. Technology in all sectors exhibit constant return to scale implying constant average and marginal cost. Firm's output is sold on the domestic market or exported to other regions through a constant elasticity of transformation (CET) function. The structure of production are illustrated in Figure 1. The CET function can be partially or entirely turned off in the model, in such case, exports and domestic sales become perfect substitutes.

Demands -- Agents in each region value products from different regions as imperfect substitutes (the Armington assumption). The private household in each region maximizes a Stone-Geary utility function over the 13 composite goods, subject to their budget constraint, which leads to the Extended Linear Expenditure System (ELES) of household demand

functions. Household savings are treated as demand for future consumption goods with zero subsistence quantity (Howe, 1975). An economy-wide consumer price index is specified as the price of savings. It represents the opportunity cost of giving up current consumption in exchange for future consumption (Wang and Kinsey, 1994). Government spending and investment decisions in each region are based on Cobb-Douglas utility functions, which generate constant expenditure shares for each composite commodity. In each region, firm intermediate inputs, household consumption, government spending and investment demand constitute total demand for the same Armington composite of domestic products and imported goods from different sources, A two-level nested CES aggregation function is specified for each composite commodity in each region. The total demand is first divided according to geographical origin under the assumption of cost minimization. Sectoral import demand functions for each region are derived from the corresponding cost function according to Shephard's lemma. Complete trade flow matrices for all trade partners are part of the model solution.

There is an international shipping industry in the model to transport products from one region to another. Each region is assumed to allocate a fraction of the output of its transportation and service sector to satisfy the demand for shipping which is generated by interregional trade. The global shipping industry is assumed to have a unitary elasticity of substitution among supplier sources. This means the margins associated with this activity are commodity/route specific. In equilibrium, the total value of international transportation services at the world price equals the sum of the export proportions of the service sector's output from each region.

Trade-Distorting Policy -- The government in each region is assumed to impose import tariffs, export subsidies, and indirect taxes, all in ad *valorem* terms, Tariff and tax (subsidy) rates vary by sector and by destination.

Price System -- There are 10 types of prices for the good with same sector classification in each region. They are value-added prices, aggregate intermediate prices, average output prices, composite good prices, consumer prices, producer prices, export prices, import prices, f.o.b. prices, and c.i.f. prices. The value-added price equals the unit cost of primary factor inputs. The aggregate intermediate price is a fixed proportion (IO coefficients) weighted average of composite good prices. A CES aggregation of the two equals the average output prices. Adding to it the production taxes yields the producer prices which are tax inclusive CET aggregation of domestic and export prices. Sellers receive this price. The composite good price is a tax inclusive CES aggregation of domestic and import price, which in turn is an aggregation of tariff inclusive import prices from different sources. The consumer price is the composite good price plus sales tax. Buyers pay this price. The f.o.b. price of each Armington good is the firm's export price plus the export taxes or minus export subsidies. Adding to it the international transportation margins yield the c.i.f. price. An exchange rate, as a conversion factor, translates world market prices into domestic prices. An adjustable exchange rate in the model implies a change in domestic price index is sufficient to sustain a constant current-account balance measured at world prices.

Equilibrium -- Equilibrium is defined as a set of prices and quantities for good and factors in all regions such that (i) demand equals supply for all goods and factors; (ii) each industry earn zero profit; and (iii) gross investment equals aggregate savings in each region.

Choice of Numeraire -- In common with other CGE models, only relative price matters. The absolute price level must be set exogenously. The aggregate consumer price index in each region is used as numeraire. The advantage of this normalization choice is that factor returns and household income in model solution are in real terms. Moreover, the equilibrium exchange rates defined in the model are also in real terms, and can be seen as equilibrium price-level-deflated (PLD) exchange rates, using the country's consumer price indices as deflators (Lewis, Robinson, and Wang, 1995).

Macro Closure -- Macro closure of a CGE model has two aspects: macro accounting balances and assumption about macro adjustment behavior. There are three major macro balances in each region: (i) the government deficit (surplus); (ii) aggregate saving and investment; and (iii) the balance of trade. Although each agent has a balanced budget in equilibrium, there is no presumption that bilateral trade flows between any two regions are balanced. They are determined endogenously. The government deficit or surplus is the difference between revenues and expenditures, one of which has to be fixed exogenously.

In the benchmark equilibrium, all three macro balances hold. The behavioral specification of macro closure in a CGE model involves choice of a mechanism by which macro balances are brought back to equilibrium when exogenous shocks disrupt the benchmark equilibrium during an experiment. Thus, a macro scenario is imposed on the CGE model, which then traces out the sectoral implications of the assumed macro behavior (Devarajan, Lewis, and Robinson, 1990). Because the macro behavior is not based on optimizing behavior by rational agents in the model, different assumptions about the macro adjustment process may lead to different results.

Since the major purpose of this study is to estimate the impact of differential trade liberalization, the savings-investment gap is held constant in each region for all the simulations conducted by the model. This is achieved by keeping fixed balance of trade, total real government expenditures, and aggregate real investment in each region. Thus, the government deficit (saving) is endogenous and the model is investment driven. If government revenue changes because of a reduction in tariffs, the macro economic effect will be either a change in the exchange rate or a change in household savings, or both, since the induced government deficit is financed by foreign capital inflows or domestic borrowing.

By a macroeconomic identity, the fixed balance of trade implies that a constant sum of domestic savings and taxes in real terms is needed to finance fixed investment plus real government expenditures. Thus, any changes in real GDP in the model will go exclusively to changes in real consumption, making it easy to compare the results from different simulations.

The model is neoclassical in spirit. Prices in each region's product markets are assumed to be flexible to clear the markets. Each region is assumed to have a fixed amount of arable land specific to agriculture.

Static and Medium Term Accumulation Effects- There are usually two types of gains from trade liberalization: the gains from more efficient utilization of resources, which lead to a one-time permanent increase in GDP and social welfare, and the gains from a "medium-run growth bonus", which compound the initial efficiency gain and lead to higher savings and investment. The static efficiency gains induce higher income and lower prices for capital goods, accelerate capital accumulation, and lead to more capital stock available in the economy. This, in turn, yields more output, leading to further savings and investment. As Francois et al. (1995) have pointed out, this type of mid-term accumulation effect is different from any long-run, permanent growth effect induced by human

capital and technology improvements, since it will ultimately decline to zero over time.

To quantify these two types of gains, two alternative capital market closures can be chosen in the model: one static, and one steady-state. Under the static capital market closure, the aggregate productive capital stock is fixed in each region, and the region-specific average rental rate adjusts to ensure that regional capital is fully utilized. It is the empirical analogue of the comparative-static analysis that is common in theoretical work. Under the steady-state capital market closure, the return of capital is held constant while the capital stock in each region is endogenously determined. This closure assumes that since each region's aggregate capital stock is at its steady-state level in the benchmark equilibrium, liberalized trade will increase capital returns due to more efficient allocation of resources. In a dynamic sense, this will lead to a higher savings and investment rate. More capital stock in the economy will drive down the marginal productivity of capital, thus decreasing the return of capital until its initial level. Although this simulation cannot provide information about the transition path of how the capital price in each region returns to its steady-state equilibrium after an external shock, it can shed some light on the approximate size of the accumulation effect from trade liberalization-induced investment growth in a classical Solow-type growth model at almost no additional implementation cost. The theoretical underpinnings of this approach are based on the concept of invariant capital stock equilibrium proposed by Hansen and Koopmans (1972), and it was introduced into CGE analysis to estimate the accumulation effects of trade liberalization by Harrision, et al. (1995).

THE RESULTS: IMPACT OF REGIONAL TRADE LIBERALIZATION

Alternative Scenarios

There are 4 sets of counterfactual experiments carried out by this study:

Scenario I -- The impact of Uruguay Round trade liberalization,
Scenario II -- The impact of AEFA trade liberalization,
Scenario III -- The impact of APEC trade liberalization, and
Scenario IV -- The impact of global trade liberalization.

For the last 3 scenarios, experiments are repeated for each scenario with two simulations: one with trade liberalization only taking place in the two sugar sectors (EXP 1) and the second trade liberalization taking place in all sectors (EXP 2). Therefore, all together 7 simulations were conducted. In each simulation, the steady state capital market closures were adopted.

For scenario I, the percentage reduction in import protection rates by sector and by region agreed to in the Uruguay Round is presented in table 6. The data for non-sugar are aggregated from version 3 GTAP database, which is based on World Bank estimates, covering 31 GTAP sectors (except 6 service sectors) and 28 regions (except China and Taiwan Province of China). The average reduction in domestic agricultural support is 20 percent for developed countries, 13.3 percent for developing countries (but except the sugar crops sector). The reduction of agricultural export subsidies is 36 percent for developed countries and 24 percent for developing countries, based on estimates by Francois et. al.(1995). To simulate the termination of Multi Fiber Arrangement (MFA) quota system, the quota rent equivalent export taxes are eliminated for all developing countries.

For the other 3 scenarios, APEC trade liberalization means reducing all bilateral protection to zero among North America, Japan, AUS/NZL, China, Indonesia, the Philippines, Thailand, MYS/SGP. AEFA trade liberalization means reducing all bilateral protection to zero among Indonesia, the Philippines, Thailand, and MYS/SGP. Global trade liberalization means reducing bilateral protection rates to zero for all regions. In the experiments of trade liberalization in all sectors for all 3 scenarios, the termination of MFA quota system is also incorporated. We assume that the quota rent equivalent export taxes are eliminated among the trade liberalization regions.

For each of those experiments, the CGE model generates results regarding the effects on social welfare, terms of trade, the volume of trade, output, the wages paid for each factor, and changes in prices and resource allocation. The difference between the assumed scenarios and the base case is our estimates of the impact of regional trade liberalization. However, our estimates should be regarded as results from controlled experiments rather than as forecast. In reality, actual and output patterns are affected by many more factors than just trade liberalization, such as domestic macroeconomic and income policy changes.

Aggregate Effects

Tables have been omitted due to space limitation.

Uruguay Round

Macro results -- The social welfare measured by the Hicksian equivalent variation would increase in all regions except China, because China is excluded from the Uruguay Round trade liberalization. ESU (East Europe and Former Soviet Union) gains little because FSU is also excluded in the Uruguay Round trade liberalization. The developing countries' gains are large because of the small size of their economies, relatively high trade orientation, and low capital return rate.

The termination of MFA quota system and trade liberalization in agriculture and food are two important outcomes of the Uruguay Round, they would result in higher prices for agricultural products and lower price for textile. Consequently, the terms of trade of developing countries, which export textiles to developed countries, improves. The terms of trade of EU, AUS/NZL, and USA/CAN would also improve because they are important exporters of agricultural products. But Japan is an important importer of agricultural products, this explains why its terms of trade would decline

The trade liberalization of Uruguay Round expands global trade. India and ASEAN countries exports would increase rapidly because of the elimination of MFA quota system and their comparative advantage in labor-intensive textiles products. There would be little changes in the trade of China and ESU, even the exports of China would decline slightly.

Sugar -- The sugar production of importers would decline and sugar production of exporters would increase, except for EU and MYS/SGP. The production of sugar in EU would decline because of its high protection in sugar sector and the reduction of export tax. Since the production of sugar in MYS/SGP were almost all exported, the increase of sugar prices in world market after UR trade liberalization would result in increase of export and production of sugar of MYS/SGP. Japan has one of the most heavily protected sugar sectors in the world sugar sector before UR, so its production of sugar would suffer the largest decline.

The gains in UR trade liberalization would promote the increase of demand for sugar. The demand for sugar in Thailand would increase 6 percent, because it gains most relative to the size of its economy.

The increase of net exports is mainly provided by Thailand, Brazil and ROW. Although AUS/NZL is an important exporter of sugar, UR trade liberalization would not result in its rapid increase of export, because much of its resources is reallocated in the grain sector.

AEFA

Macro results -- AEFA trade liberation of the sugar sectors would increase the social welfare of all the ASEAN countries, although the improvement is very limited. Thailand s terms of trade would improve, while the other three ASEAN countries decrease, because of the increase in Indonesia, MYS/SGP, and Philippine s demand for Thai sugar.

AEFA trade liberation in all sectors would improve the ASEAN s social welfare, and the trade diversion would slightly decrease the social welfare of Japan, AUS/NZL and India. But the distribution of gains is uneven in ASEAN regions. MYS/SGP gains much more than the other three countries, because there is a strong trade connection between MYS/SGP and the other three countries, but the trade among the three countries is relatively small.

Sugar -- In ASEAN countries, Thailand is a net exporter of sugar and its imports of sugar are almost zero. The Philippines is also a net exporter, but most of its sugar exports are shipped to the United States, and the Philippines has a heavy import protection on domestic sugar market. Indonesia is a net importer of sugar, it also has heavy protection for its own sugar sector. When all the import protection in sugar sector among ASEAN region are eliminated, sugar production and sugar exports of Thailand would increase, and, on the contrary, imports of Indonesia, MYS/SGP, and Philippine would increase. In the experiment of trade liberalization in all sectors, the pattern of change in sugar trade is largely the same as the experiment of sugar-sector-only liberalization.

APEC

Macro Results -- All the APEC members would gain in the APEC trade liberalization, while non-APEC members would lose. In the experiment of trade liberalization for sugar sector, the terms of trade of the main exporters of sugar, Thailand and AUS/NZL, increase. In the experiment of trade liberalization in all sectors, the increase in demand for agricultural products among USA/CAN, AUS/NZL, China, and Indonesia would improve their terms of trade.

Because of the trade diversion, the trade of non-APEC members would decrease, while the trade of APEC countries would increase. The trade of ASEAN and China would increase the most because of the elimination of MFA quota in textile exports to USA/CAN.

Sugar -- AUS/NZL and Thailand are the main exporters of sugar in the APEC area. Their production would increase significantly in the APEC trade liberation. USA/CAN, Japan, China, and Indonesia would decrease their production because their high import protection to APEC regions is eliminated. The production in ROW and Brazil would also decrease because of the trade diversion.

The pattern of changing in the experiment of trade liberation in all sectors is similar to the sugar sector trade liberalization experiment. But the trade liberalization in other sectors would affect the resource allocation, and thus affect the sugar sector. The production and exports of sugar of AUS/NZL in EXP 2 (all sectors) is smaller than EXP 1 only sugar sector), while production and export of Thailand in EXP 1 is larger than EXP-2. This is because the trade liberalization in agriculture results in the booming demand for agricultural products of AUS/NZL, promotes the growth of production and exports of AUS/NZL s grain sector, and results in the contraction of sugar crops sector and sugar processing sector. While Thailand has more comparative advantage in the sugar crops sector than other agricultural sector, therefore, it would import more other grain products and produce more sugar products. For similar reasons sugar exports of USA/CAN would decrease.

Global Trade Liberalization

Macro Results -- Global trade liberalization promotes the social welfare increases in all the regions. Similar to the previous scenarios, developing countries gain more relative to the size of their economies. The pattern of change in terms of trade is also similar to the previous scenarios.

Sugar -- In the global trade liberation scenario, AUS/NZL, Thailand, Brazil and ROW would increase their production of sugar, while EU would decrease much of its production (table 8-C). The increase of production and exports of AUS/NZL and Thailand would be less than that in the APEC trade liberalization scenario, because some trade opportunities would transfer to Brazil and ROW.

CONCLUSIONS

Summary

Sugar is an important commodity in world agricultural commodity market, which is characterized by heavy government intervention, large price fluctuation, growing market for sugar substitutes, and widespread production in many parts of the world. As Uruguay Round policy provisions are implemented and APEC and ASEAN trade liberalization policies are carried out, it is critical for sugar exporting and importing countries to assess the effects of these trade reforms on their sugar markets.

The objective of this study is to use a CGE framework that includes majority of the sugar producing and trading countries to quantify the effect of the trade liberalization agreements negotiated under the UR on sugar production, consumption, trade, and prices of the major sugar exporting and importing countries. A 13-region and 13-production-sector model is constructed for this study and we found the following results.

CONCLUSIONS

In general, the conclusions can be summarize as follows:

1. The trade liberalization of the Uruguay Round will expand global trade and social welfare would increase in all regions or countries, except China (China is excluded from the UR trade liberalization). The developing countries gains are large relative to their smaller size of economies and high trade orientation. The gains in UR trade liberalization promote the increase of demand for sugar. Sugar production of importers would decline and sugar production of exporters would increase, except EU and MYS/SGP.

2. AEFA trade liberalization in all sectors would improve the ASEAN's social welfare, but the distribution of gains is uneven in ASEAN regions. AEFA trade liberalization in sugar sector would increase the social welfare of all ASEAN countries, although the improvement is rather limited. The terms of trade improve for Thailand, while the other three ASEAN countries, Indonesia, MYS/SGP, and the Philippines, decrease because of their demand for Thailand's sugar. When all the import protection in sugar sector among ASEAN regions are eliminated, sugar exports of Thailand would increase and imports of Indonesia, MYS/SGP, and Philippine would increase.

3. All APEC members would gain in the APEC trade liberalization, however non-APEC members would lose. In the experiment of trade liberalization in sugar sector, the terms of trade of the main exporters of sugar, Thailand and AUS/NZL, increase. In the case of trade liberalization in all sectors, the increase in demand for agricultural products among USA/CAN, AUS/NZL, China and Indonesia would improve their terms of trade. In the APEC sugar trade liberalization, sugar production in AUS/NZL and Thailand would increase the most. USA/CAN, Japan, China, and Indonesia would decrease their sugar

production, because of high import protection to APEC regions is eliminated. The production of ROW and Brazil would also decrease because of trade diversion. The pattern of changes in the experiment of trade liberalization in all sectors is similar to the sugar trade liberalization experiment.

4. Finally, global trade liberalization would promote welfare increases in all regions. Similar to the UR scenario, developing countries' gains are large relative to the size of their economies. The pattern of change in terms of trade is also the same as previous scenarios. In the global trade liberalization scenario, AUS/NZL, Thailand, Brazil and ROW would increase their production of sugar, while EU would decrease much of its production. The increase of production and exports of AUS/NZL and Thailand would be less than APEC trade liberalization scenario, because some trade opportunities would transfer to Brazil and ROW.

IS SUGAR "PURE WHITE AND DEADLY?"

Prepared by the Nutrition Programmes Service, Food and Nutrition Division of the FAO.

INTRODUCTION

The presentation of a nutrition paper in a conference of economists, commodity specialists and traders aiming to discuss sugar production and trade issues is a rare, but laudable event. It is, of course, fully in line with FAO's broad mandate to assure food availability and nutritional well being for all people and to introduce nutritional considerations in all aspects of economic development.

Sugar in the diet is popular primarily because of its sweetening properties. It also has many other unique properties that make it valuable in a variety of applications in food preservation, processing and preparation. However, its primary nutritional characteristic is that it simply provides a ready source of dietary energy.

Not surprisingly, sugar is highly appreciated and sought after by most people as it has a unique capacity to make foods appealing and desirable. As more and more people over the years have acquired easy access to a variety of sweetened foods, the question of overconsumption has arisen among some in the medical and health communities and, accordingly, in the public at large. Enormous amounts of effort and resources – often applied with a Crusader's zeal - have gone into denouncing sugar and in trying to identify and quantify the detrimental effects of sugar consumption.

It was around 1850 when an exponential rise in sugar consumption was first observed in the United Kingdom, where at the time, consumption per person per year was similar to that of developing countries today. This major increase in consumption of a substance that appeared to appeal to people's hedonistic tendencies by virtue of its sweet taste, made it a natural target for society's ills. The continuing rise in consumption after World War II led researchers to query whether, in fact, high levels of sugar intake could be responsible for a range of health problems. Unfortunately, many were all too quick to supply answers before the results were in. Statements like "white, pure and deadly" and "empty calories" were subsequently picked up by some nutritionists, health professionals and the press, and the still widely believed myths about sugar were created. Sugar was regularly being condemned well before its "scientific" trial was over.

Years of research have now gone into trying to determine if sugar undermines health, and I am pleased to report that the evidence consistently tends to point in the opposite direction. The conclusion today: sugar as generally consumed is a safe and valuable food source. The problem remaining: many people still do not believe it.

Like all commodities, sugar, which is generally refined before being consumed, has a price. It is, therefore, not unexpected that generally more is consumed in industrialised countries than in developing ones. Total consumption figures, including its use outside the household, is around 41 kg per person per year in high sugar-consuming countries while only around 15 kg in low-income countries. Globally, sugars and other sweeteners contribute approximately 9% of the total energy supply of the world's population with very high variation in national and individual consumption patterns.

Considering the overall world food and nutrition situation, the 1996 Rome World Food Summit showed that, in spite of a decline in chronic undernutrition, there are still over 800 million undernourished people living in developing countries. It is noteworthy that these are generally countries in which large amounts of sugar are not regularly consumed. It is also important to note that much of the world's sugar is produced in developing countries, and that the issue of whether sugar is good or bad has important implications for its supply and demand. Unwarranted attacks on sugar that affect its production and trade in both domestic and international markets can have far-reaching social and economic consequences. The purpose of this paper is to look at current scientific knowledge about the role of sugar in health and disease.

NEW SCIENTIFIC KNOWLEDGE

The past thirty-plus years of intensive research into sugars, carbohydrates and dietary fibres has led to significant strides in our understanding of the metabolism and physiological effects of these dietary components. Epidemiological studies have delved into the relationships between food consumption, including that of sugars, and health status, and earlier concerns have been clarified. Our understanding of dietary behaviours in different food situations and among different populations and age groups has also increased dramatically during this time. To bring these new findings together and make use of them for nutrition improvement and maintaining health, FAO and WHO convened the joint Expert Consultation on Carbohydrates in Human Nutrition in Rome in April 1997.

In preparation for this consultation extensive literature reviews on non-communicable diseases and all aspects of carbohydrate digestion, absorption, metabolism, and behaviour were examined by a group of experts from thirteen countries. These examinations included sucrose (table sugar) and the different sugars contained in the myriad of foods in world diets. In brief, the results, based on solid scientific grounds, dispelled the generally negative myths about the consequences of sugar consumption. The Report of the Consultation and its Recommendations were given world-wide dissemination through the Nutrition site of the FAO Homepage on the Internet (www.fao.org). They will be circulated through other channels once the Report is published.

Selected findings from this and other sources are discussed as follows:

<u>Sugar does not make people fat</u>

In high-income countries there is great public health concern about the rising percentage of obesity as expressed in high body fat accumulation. In the richest countries, more than 25% of the population can be considered obese, but its prevalence is also rising in the developing countries, even among the poor income instances. Since obesity is a key factor in the aetiology of several degenerative diseases, the understanding of the role of sugar as a food energy source is therefore of great importance.

Maintaining stable body weight requires that total energy consumed be balanced against total energy spent. Therefore, excess energy consumption in any form will promote body fat accumulation. When it is realised that dietary fats and oils have over twice the food energy value of sugars, it becomes clear that the major risk factor for obesity is excess dietary fat, not carbohydrates or sugar. Coupled with this unequal energy contribution is the fact that carbohydrate, including sugar, is the preferential energy source for the body. That is, carbohydrates are oxidised first and leave the more easily accumulated fat as the excess energy source.

Interestingly, findings generally show an inverse association between the intake of sugars (total sugars) and obesity and fat intake. Indeed, epidemiological data from a number of countries show that people with higher sugar intakes are less likely to be obese than those with lower sugar intakes. Also, there is no conclusive evidence indicating that the sweetness of sugar contributes to increased appetite. In fact, the opposite is generally true: the body tends to have a much better appetite-reduction response to carbohydrates and sugar than it does to dietary fat.

In summary, the consultation found no evidence to implicate either sugar or starch in the promotion of obesity other than their contribution to total energy intakes.

Sugar does not cause diabetes

Table sugar, or sucrose, is made up of one molecule of glucose linked with one molecule of fructose. Once eaten, the chemical bond is split and both sugars follow different absorption paths: glucose is absorbed via a dynamic process whereas fructose enters through a passive mechanism. Following ingestion of carbohydrate, glucose increases blood glucose and stimulates the release of insulin. The latter hormone signals to the cells of the body to absorb glucose, thus reducing its concentration in blood. In diabetes patients this control mechanism is impaired, and historically much attention had been given to helping such patients regulate their sugar intake.

Many factors influence the rate of serum glucose increase following consumption of carbohydrate, ranging from the type of carbohydrate and other nutrients consumed to physical activity levels. Among the more important discoveries about carbohydrate over the past twenty years has been that some of it is not absorbed at all in the small intestine and becomes fermented in the colon. This carbohydrate that goes to the colon contributes little energy and is not glycemic.

A system, called the glycemic index (GI), has been devised to rank foods empirically on the basis of their ability to contribute to increased blood glucose levels. It is particularly interesting to note that while pure glucose is the most glycemic food, sucrose is not highly glycemic. In fact, it is often surprising to learn that sucrose is rated below maize, rice, wheat and potatoes. This is due to the high amount of fructose, which has a very low GI, present in sucrose. The use of the GI has totally transformed dietary advice for many diabetics who are generally encouraged to consume foods with a low glycemic index. As a result, diabetics are allowed to consume even sugar, generally up to 50 grams per day.

The cause for non-insulin-dependent diabetes (NIDDM) is insulin resistance at the cellular level, also referred to as glucose intolerance. Sugar intake is not the cause of the development of this clinical state. In fact, the most important contributing factor towards the development of NIDDM is obesity.

Epidemiological studies show that high percentages of non-insulin dependent diabetes (NIDDM) are found in all population groups undergoing rapid cultural changes and changes from traditional diets. There is no doubt that genetic factors are involved even though the precise mode of inheritance has not yet been established. Diet and lifestyle-related conditions, which lead to obesity, will clearly influence the risk of non-insulin deficient diabetes.

The main disease management feature for this condition focuses on reduction of weight, avoidance of obesity and, strengthening low fat diets including a wide range of cereals, vegetables and fruits with emphasis on low glycemic index. Sucrose and other sugars have not been directly involved in the aetiology of non-insulin dependent diabetes and key dietary advice for diabetics has been to distribute the intake of carbohydrates throughout the day.

Sugar does not cause cardiovascular diseases

Understanding the results of early studies on the metabolism of sugar resulted in the concern that glucose was not being used for the production of glycogen, i.e. energy storage in the body, but rather for the production of fatty acids and triglycerides. It appears, however, that carbohydrate is not readily transformed to fat by the body but contributes to obesity through a fat-sparing mechanism. In other words, carbohydrate is the first choice of the body as a source of energy and is preferentially oxidised. Fat tends to be oxidised only when available carbohydrate has been oxidised first. Ingested fat also directly contributes to fat stores, by contrast to carbohydrate.

The expert consultation reported that genetic factors are involved in the aetiology of coronary heart diseases and influence both the atherosclerotic and thrombotic processes underlying clinical manifestations of this disease. Dietary factors may influence these processes directly or via a range of cardiovascular disease risk factors. Obesity, particularly when centrally distributed in the body, is associated with an appreciable increase in the risk of coronary heart disease. There is also evidence implicating specific nutrients and, in particular, the high intake of some saturated fatty acids, which appear to be promoters of coronary heart disease. On the other hand, there is increasing evidence that a range of antioxidant nutrients provide strong, protective effects. Increasing carbohydrate intake can assist in the reduction of saturated fat, and many fruits and vegetables, rich in carbohydrates, are also rich in several antioxidants. Cereal foods rich in non-starch polysaccharides have been shown to be protective against coronary heart disease in a series of prospective studies. There is no evidence that sucrose plays a causal role in the aetiology of coronary heart disease.

The cornerstone of dietary advice aimed at reducing the risk of coronary heart disease is to increase the intake of carbohydrate-rich foods, especially cereals, vegetables and fruits rich in non-starch polysaccharide, while reducing the intake of fat. Among the overweight and obese, it is important to reduce total fat intake while encouraging the consumption of appropriate carbohydrate-containing foods. There has been concern that a substantial increase in carbohydrate-containing foods at the expense of fat might result in a decrease in high-density lipoprotein and an increase in very low-density lipoprotein and triglycerides in the blood. There is, however, no evidence that this occurs when the increase in carbohydrate results from increased consumption of vegetables, fruits and appropriately processed cereals, over prolonged periods.

Sugar intake does not lead to micronutrient deficiencies

Table sugar, i.e. sucrose, has been labelled a food or a nutrient consisting of only “empty calories”. It is believed that, if used in substantial quantities, it might replace other nutrients in the food or diet. While it is, of course, true that refined sugar does not contain micronutrients, examination of data looking at nutrient intake data, for example, men of different ages in the

United States, consuming widely differing amounts of sugar (less than 26g, up to more than 60 g/1000 kcal/day), show that there is no risk of becoming mineral or vitamin deficient even when higher intakes are recorded. Only fibre intake was reduced slightly in high sugar diets. In fact, high sugar consumers are more likely to reach at least two-thirds of their recommended dietary allowance of essential vitamins and minerals than are low sugar consumers.

As to fat intake, the data showed a marked decrease in the higher intake group. The supposition that sugar automatically replaces foods rich in micronutrients, adversely altering micronutrient intake, therefore, is without foundation. Common sense would indicate this since there appears to be a limit to total daily sugar intake, and sugar intake has to be seen as an integral part of the whole diet.

Sugar does not cause hyperactivity in children

The notion that sugar adversely affects human behaviour has circulated since the 1920s. By mid-century sugar was associated with the condition called "tension fatigue syndrome". Twenty-five years ago sugar consumption was related to a condition called "functional reactive hypoglycaemia". The strong belief in the relationship between sugar and anti-social behaviour has resulted in studies to demonstrate a correlation between sugar intake in children and hyperactive behaviour. Double blind studies followed earlier less rigidly controlled ones, and a meta-analysis was undertaken including a look at the claim that sugar intake improves cognitive performance.

The experts of the consultation, however, after discussing this extensive review of the scientific literature on sugar and behaviour produced for the meeting, declared that there was no evidence to support the claim that refined sugar intake has any significant influence on either behaviour or cognitive performance in children.

Sugar consumption can lead to dental caries

Dental caries affect the hard tissues of the teeth. Bacteria-producing plaque (the accumulation of sugar and other carbohydrate foods in a dense mass on the teeth) are responsible for the formation of acids which demineralise the hard tissue of the teeth.

The expert consultation confirmed that the incidence of dental caries is influenced by a number of factors. Foods containing sugars or starches may be easily broken down by alpha-amylase and bacteria in the mouth and can produce acid, which increases the risk of caries. Foods with a high glycemic index produce more pronounced changes in plaque pH than low glycemic index carbohydrate foods. However, the impact of these carbohydrates on caries is dependent on the type of food, frequency of consumption, degree of oral hygiene performed, availability of fluoride, salivary function and genetic factors.

Regarding dental health, the most important observations emerging from the recent epidemiological studies and reviews is "that more and more populations are characterised by a decreasing caries prevalence in the young generations, mostly independent from intake of sugars and other carbohydrates". All these findings call for a less biased and more rational approach to the relationship between sugar, carbohydrates and dental caries and clearly confirm that prevention programmes to control and eliminate dental caries should focus on fluoridation and adequate oral hygiene, rather than on sucrose intake alone.

THE MYTH REMAINS

The Joint FAO/WHO Expert Consultation brought to light strong evidence that a new and dispassionate voice is needed when speaking about sugar, its production, processing and consumption. Yet, it is difficult to translate the results of scientific endeavours into easily understood messages for the public. It is obvious that one expert consultation and continued scientific research, even with convincing results, will not immediately alter some people's firmly held opinions about specific foods or the consequences of certain dietary intakes. For many, among both the public and some nutritionists, the myth regarding the dire consequences of sugar remains and will need time before it can be corrected.

This has significance for policymakers dealing with production and trade of food items, for the food industry attempting to expand their offered products, and for nutritionists and health professionals setting national dietary goals, establishing dietary guidelines and preparing nutrition education and information programmes for the public. The interesting difference of projections of sugar demand when based on general economic models or on habit formation models is only one example of how an equation can change when the human factor is included.

General food habits often change slowly, although rapid changes can also take place due to external and internal forces in the family. In Norway, for example, in spite of a concerted nutrition education programme, it took twenty-seven years (nearly a generation) to reduce energy intake from animal fat from 29% to 23% (1961-1988). It also took fourteen years to reduce total fat intake from 41% in 1975 to 35% in 1988.

Therefore, in order to dispel the widely-held "sugar is deadly" myth and to allow sugar to be recognised as a valuable component of people's diets, creative and sustained nutrition education campaigns will be needed. At the heart of the matter is the simple notion that sugar is an inexpensive source of energy that helps make a variety of foods taste better. This can be of particular significance, for example, in regard to child feeding where energy density and taste are of paramount concern. Sugar can play an important role in improving child-feeding practices, but often concerted nutrition education programmes will be needed to overcome outmoded or prejudiced views about its appropriateness. Developing such nutrition education programmes will be challenging as they cannot, both for nutritional reasons and cost effectiveness, focus on only one food item. In fact, for all people of all cultures, it is the whole diet that must be addressed.

In line with this, FAO has developed a simple set of nutritional guidelines that are intended to stimulate the development of local nutrition education initiatives. This FAO initiative, entitled "Get the Best from Your Food," is based on the realisation that a variety of diets and dietary patterns are consistent with good health, and that there are no good or bad foods, *per se*, only good and bad diets and lifestyles. What this means is that there is no global, ideal diet or dietary pattern appropriate for all people, everywhere. It also means that the appropriateness of a given diet to meet one's nutritional needs must be judged in light of a variety of individual requirements and local conditions.

The general messages promoted in the "Get the Best from Your Food" materials are: "Enjoy a variety of foods," "Eat to meet your needs," "Protect the quality and safety of your food, " and "Keep active and stay fit." These simple messages can be the key building blocks for national nutrition education campaigns designed to meet local needs and conditions.

FAO has actively been promoting the development of collaborative nutrition education campaigns involving governments and private sector partners. In fact, various elements of the food industry have generously supported the translation, adaptation, printing and introduction of local versions of the "Get the Best from Your Food" materials. There is considerable scope for increasing such co-operative arrangements, and we call upon both the food industry and those in government responsible for nutrition education to

explore how they could best work together to develop appropriate education programmes for the public. Only in this way can new knowledge that will ultimately dispel the myth that sugar is deadly be disseminated consistently.

CONCLUSION

In recent years, the science of sugars and their metabolic and physiological effects has become better understood. Similarly, much of the public has become better informed as to the positive effects that sugar can have in their diets, after years of unnecessary fear and suspicion.

Simply stated: eating sugar is not deadly. It does not cause obesity, diabetes, cardiovascular disease, hypoglycaemia, hyperactivity, cancer or lead to micronutrient deficiencies. On a positive note, sugar is a tasty, low-cost energy source that helps make a variety of foods more palatable and desirable. Given the wide-spread prevalence of undernutrition (chronic energy deficiency) throughout the world, the positive contribution that sugar can make to increasing energy intakes among the poor should be stressed. Concurrently, the role that sugar can play in combating obesity by lowering the energy density of high-fat diets should also be noted.

It is unrealistic to expect that the results of a scientific review of carbohydrates and sugar, even one undertaken and reported by a Joint FAO/WHO Expert Consultation, can do much on its own to change the public's misconceptions about sugar and health. To the contrary, correcting the years of misguided dietary advice will require concerted and consistent efforts in nutrition education. To be most effective, co-operative efforts among producers, food industry technologists, nutritionists, and health professionals will be needed.

The ultimate aim of nutrition education programmes is to promote adequate access to and consumption by all people of the food they need for an active and healthy life. Obviously, sugar can make a valuable contribution to meeting the energy needs of the population. However, it is also important to recognise that in many countries the sugar industry, itself, can make a valuable contribution to improved nutrition. This happens through the sugar industry's impact on economic development and income generation which are necessary to alleviate poverty and provide the social services needed to promote better nutrition for all.

In general, moderate levels of sugar intake are fully consistent with healthful dietary intakes. Efforts to limit sugar to low levels of intake (<10% energy) are, generally, unnecessary and wasteful of time and energy and, ultimately, consumer goodwill.