THE PAKISTAN SUGAR INDUSTRY: AN ECONOMIC AND POLICY ANALYSIS

Special Report Series
No. 8

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Published by the Directorate of Agricultural Policy and Chemonics International Consulting Division for the Economic Analysis Network Project in collaboration with the Ministry of Food, Agriculture, and Cooperatives, Government of Pakistan, and the United States Agency for International Development under the provisions of USAID Cntract 7?4-0491-C-00-5034

Islamabad
October 1988

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ACKNOWLEDGMENTS

The sugar industry study team would like to thank the many individuals connected with the Pakistan Sugar Industry who provided valuable background information and data for the study. Although too numerous to name individually, these include members of the Pakistan Society of Sugar Technologists and the Pakistan Sugar Mills Association, mill managers, officials of banks and the Ministry of Food and Agriculture, agricultural research scientists, and sugarcane farmers. Without their insights into the critical issues faced by the industry, and more importantly, their willingness discuss them openly with the team members, this study would not have been possible.

We are also grateful to Mrs. Nilofer Hashmi for editing and finalizing the report, and to Mr. Riaz Lodhi, EAN's data processing specialist, for providing advice to team members on software related problems throughout the study.

EXECUTIVE SUMMARY

Introduction

The sweetener industry in Pakistan consists largely of sugarcane production, and the manufacture and marketing of white sugar and gur (a traditional sweetener). Sugarcane production in Pakistan is characterized by a shorter than normal growing cycle and relatively low yields when compared to international standards. Sugarcane is moved to local mills to manufacture white sugar or is used at the farm to manufacture gur. White sugar manufacturing is relatively modern. It consists of 41 mills having a capacity of around 90,000 metric tons of cane and beets per day. Most of the capacity has been constructed since 1960. Gur manufacturing, on the other hand, is an ancient cottage industry. The making of gur and similar products such as shakkar and desi cheni is, for the most part, a supplemental farm enterprise using otherwise unused labor and animal power. The marketing of white sugar follows the usual marketing channels, directly to the consumer and indirectly through beverage manufacturers, bakers, confection makers, etc. Gur, outside of home consumption, is sold to local consumers, retailers and regional wholesalers.

Homemade sweeteners such as gur, shakkar and desi cheni are made through a process of crushing cane, and boiling, treating and cooling the juice. During the 1970s, gur and other home-made products accounted for nearly three fourths of the total sweetener supply. Since 1980, gur production has fallen and recently, in 1986/87, it accounted for about two fifths of the total sweetener supply. In this study, gur production will include gur and the gur weight equivalent of shakkar and desi cheni.

At present, sweeteners produced from maize and rice, and liquid sugars are an insignificant part of total sweetener supply. However, as the consumption of soft drinks, confections and processed food grows, fructose from maize and liquid sweeteners will probably become an important part of sweetener supply. Currently, two companies in Pakistan produce sweeteners from maize.

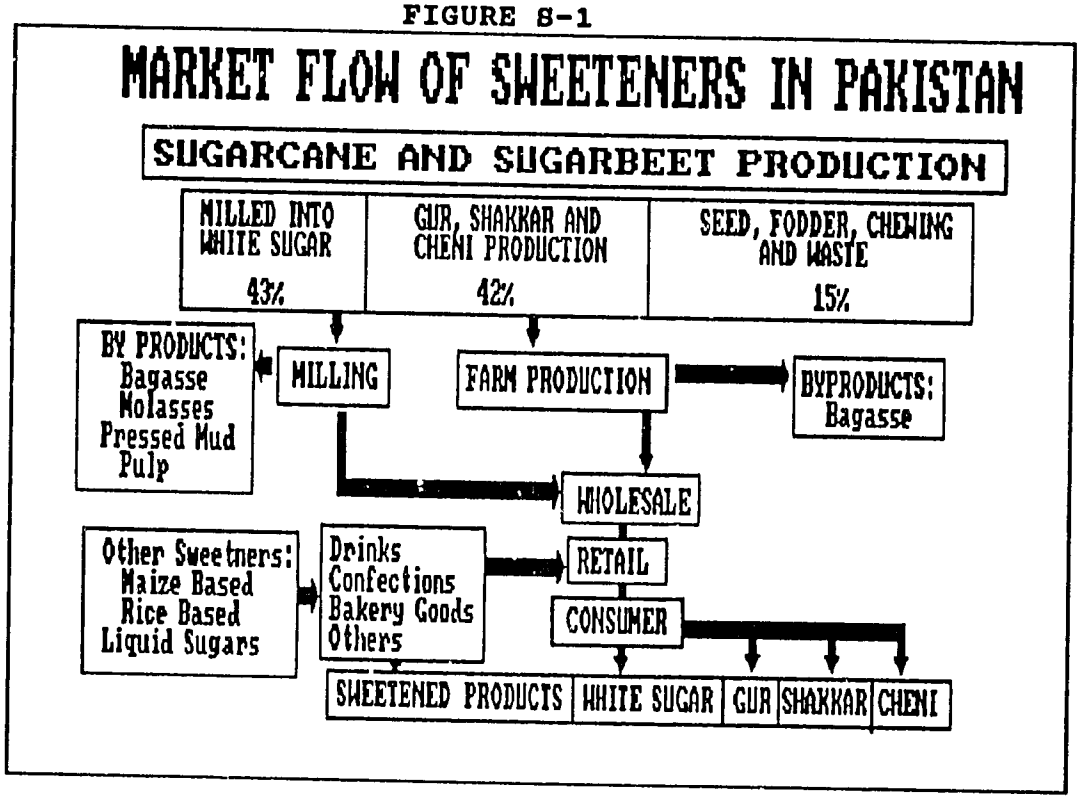
The Market Flows for Sugar and Gur

The market flow for sugar follows the usual pattern of movement from the cane or beet producer to the mill where it is converted to sugar and often stored for sales throughout the year. Sales are made to wholesalers with truckers contracted for delivery. Wholesalers sell to some large users such as beverage manufacturers and canneries and further break their bulk purchases into smaller units to sell to retailers. The retailers are usually general food or utility stores that sell direct to the consumer

and to a multitude of bakeries, restaurants, ice cream manufacturers, confection makers and small beverage manufacturers.

The market flow for sweeteners is summarized in the following figure.

FIGURE S-1



Besides sugar, mills produce a number of by-products including molasses, bagasse, and pressed mud. Molasses is part of the thick juice that will not crystallize into sugar. It is used mainly for export as a liquid sweetener and, in some cases, as a supplemental livestock feed. The unexported portion is used for domestic production of industrial alcohol, animal feed, and tobacco blending. Bagasse is the residue of the cane after it has been crushed to extract the juice. It is used to fire the juice boiling operations or to make paper and chipboard building material. Pressed mud is used as a soil amendment.

The market flow for gur is substantially different from that of sugar. Gur, for the most part, is consumed locally and is sold direct to the consumer or to a small local retailer. Gur is consumed in tea and in confections made with nuts and fruits. In some cases regional sales are made through wholesalers. Bagasse is the major by-product and is used to fire the open pan boilers for the thick juice. It is often stored for a year or more before use. In some cases it is sold as a heating fuel.

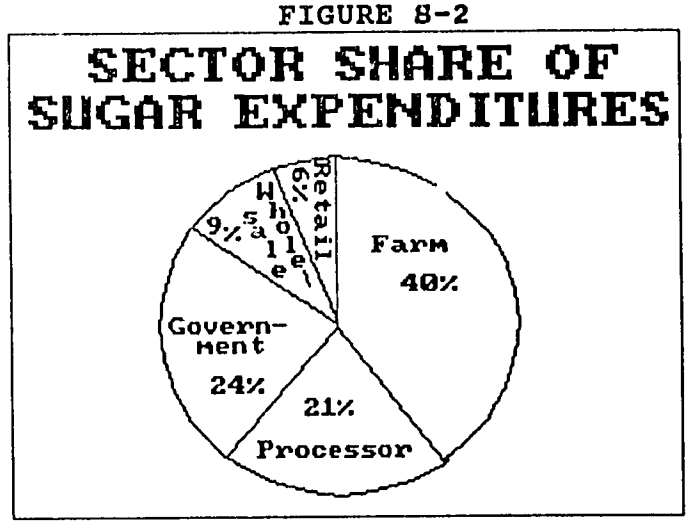
As shown by Figure S-1, about 15% of the sugarcane supplies are either waste or are used for fodder and for chewing. The rest is divided into white sugar and gur making.

In the market flow, consumer expenditures for white sugar and the by-products from its manufacture are the revenues to the sugar industry. These revenues are paid out to the farmer, processor, government, wholesaler, and retailer, as each sells to the next in the system.

In Pakistan, of the consumer's rupee spent for sugar, about 40%, goes to the farmer who produced the sugarcane. The government gets the next largest share of 24% in the form of excise taxes. The processor receives 21% of the consumer's rupee while the wholesaler (who also transports sugar from the mill to the consumer) acquires 9%, and the retailer (who stores and sells and sometimes repackages) receives 6%. These shares of consumer expenditure for sugar are summarized in Figure S-2.

The share of consumer expenditures that flow to each sugar sector in Pakistan are not strikingly different from those in other countries However, compared to the United States and the Philippines, the Pakistan share to the farmer is somewhat higher. The share to the government is much higher. In the Pakistan case the share to the farmer has been kept high to encourage self sufficiency levels of sugarcane production.

FIGURE S-2

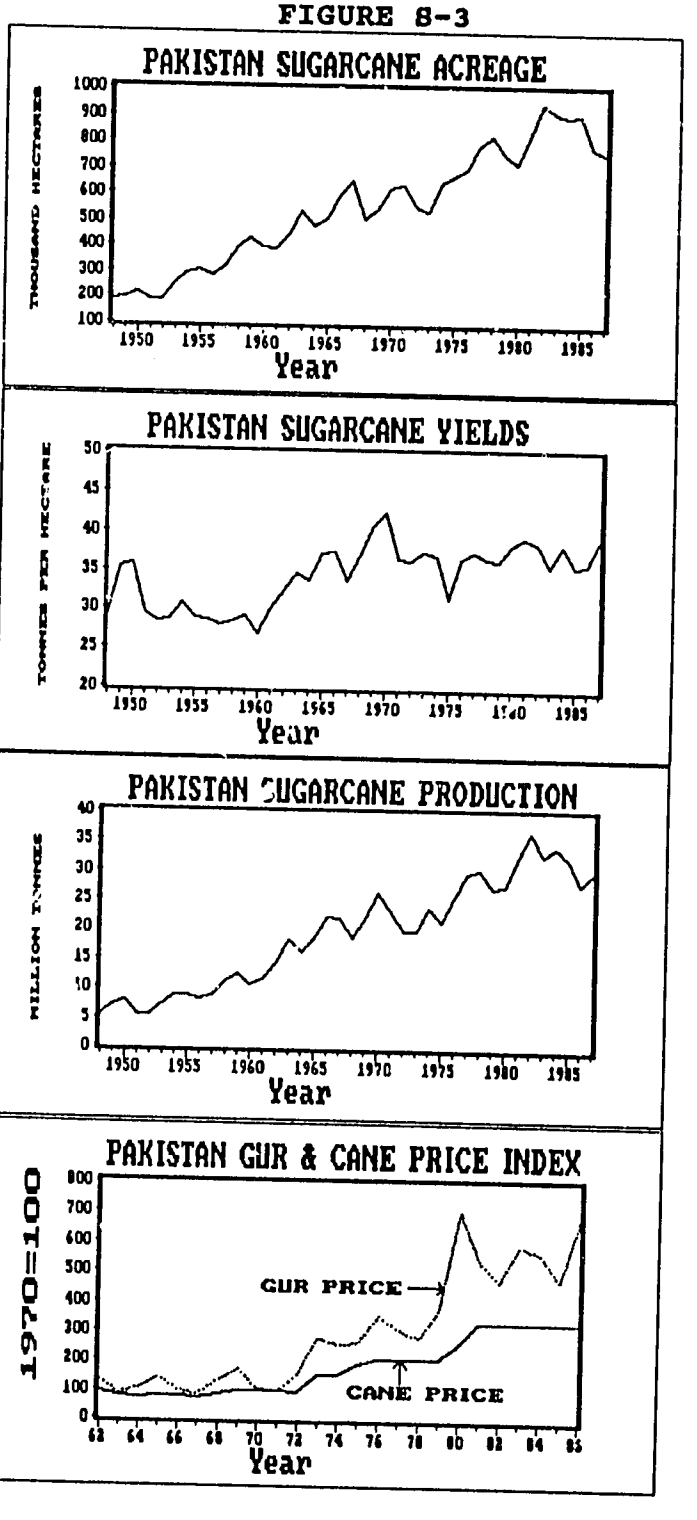


The shares of consumer expenditures that flow to each gur sector in Pakistan are much different from those for sugar. Nearly all the expenditures go to the farm producer since he is the producer and the processor. For the small amounts sold to local retailers or regional wholesalers the usual costs of transportation, storage and selling are incurred.

Farm Production of Sugarcane

One of the major sugar policy goals of the Government of Pakistan is to maintain self-sufficiency in sugar production. This has led the government to maintain support prices for sugarcane that make it competitive with other crops. Sugarcane is most directly competitive with cotton and wheat, and IRRI rice and wheat. Support has drawn acreage into sugarcane production. In addition acreage has been made available through expanded irrigation.

FIGURE S-3



As shown by Figure S-3, sugarcane production in Pakistan has advanced in rather regular cycles. The cycle involves two years of increase followed by two years of decrease. This follows from the practice in Pakistan of ratooning (growing from the roots of cut plants) for 1-2 years after each planting. The increase in production is due largely to increases in the acreage of sugarcane. Yields of sugarcane are stagnant. Since 1965, there is no evidence of trend increases in sugarcane yields. In brief, the increases in sugarcane production from 1947 to 1987 are largely a reflection of increases in sugarcane acreage.

The increases in acreage since the mid 1970s have been supported by grad-

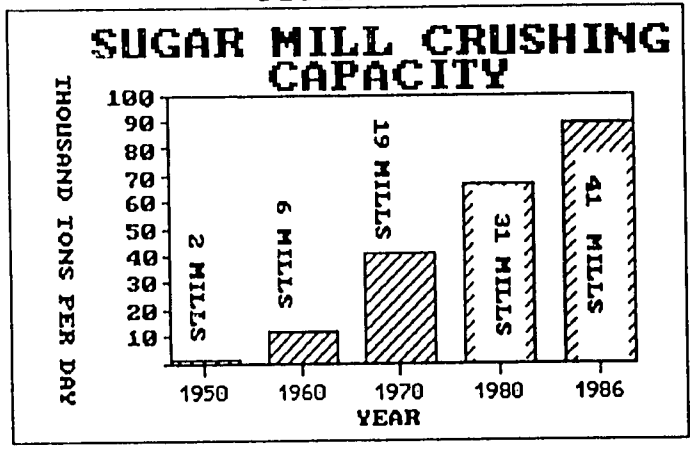
ually increasing cane prices. As cane prices have increased, gur prices have also moved up in a rather erratic pattern. However, gur prices have not increased enough to encourage additional gur production.

This summarizes one of the major problems in the sugar industry which is developing sustained yield increases that will allow sugarcane production to expand through the use of inputs other than land and water, for example, seeds, fertilizer, pesticides and more intensive labor. Cane production increases that depend on additional acreage must compete with other crops such as cotton, wheat and IRRI rice. Sugarcane occupies the land the full year so it displaces both rabi and kharif crops such as cotton and wheat, and IRRI rice and wheat.

Sugar Processing

At the time of partition there were two sugar mills in Pakistan. Since that time, the sugar industry has emerged as a major processing sector second in sales volume only to textiles. The foundations of the industry were started by the Government of Pakistan with the establishment of four sugar mills during the 1950s.

FIGURE S-4



As shown by Figure S-4, sugar mill capacity grew very rapidly during the 1960s when liberal sanctioning and credit policies coupled with a generally "pro business" policy environment helped create conditions conducive to private investment in the industry. The growth in sugar manufacturing capacity continued in the 1970s and 1980s mainly due to the considerable protection to domestic sugar production. This was provided through tariff and non-tariff restrictions on the import of sugar. During 1987, Pakistan had 41 mills operating with a capacity of roughly 91,000 tons of cane per day. This translated into about 1.2 million metric tons of sugar per year depending on the length of the sugar campaign and the quality of cane. Reported capacity was about a half million metric tons less than the annual consumption of sugar. Of the 41 mills, 9 are in the public sector representing about one fourth of the total installed capacity in the industry. However, they are owned and operated separately by a number of public sector agencies. The more prominent of these

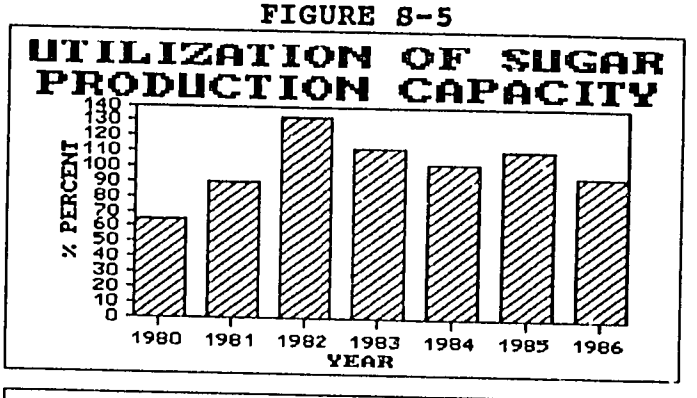
are the Punjab Industrial Development Board (PIDB), the Sind Sugar Corporation (SSC) and the Sarhad Development Authority (SDA). The SDA, the PIDB and the SSC each operate two mills in their respective provinces. No industry group either in the public or private sector, has a large share of production or sales. The biggest, the Fauji Foundation with three mills, accounts for less than 15% of total sugar production.

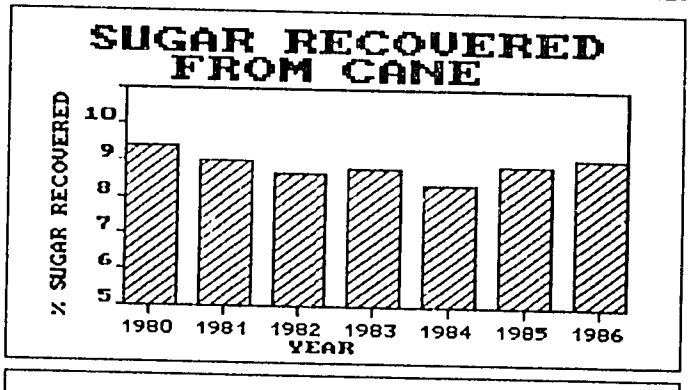
The sugar industry of Pakistan is organized. All mills are members of the Pakistan Sugar Mills Association which represents the industry with the government, the public and other industries. The Pakistan Society of Sugar Technogists is the source for most of the technical data and information related to sugar production in Pakistan. The society is made up of the professionals employed in the sugar industry.

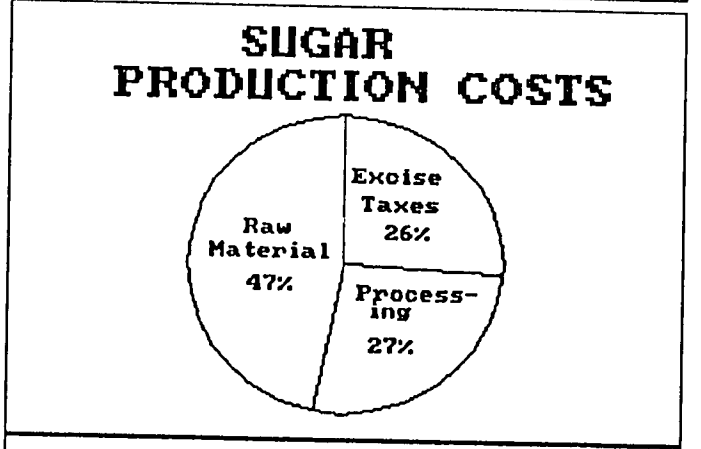
The white sugar market price was decontrolled in 1984 and for the first time, the industry must evaluate production and marketing plans and sell or store sugar as necessary to meet cashflow requirements and to enlarge profits. Processors now finance their own operating capital requirements and the government no longer owns the sugar stock.

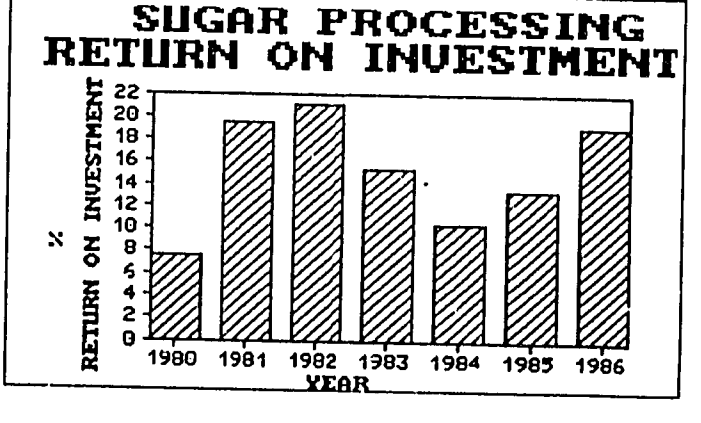
The major factors affecting profits are the util-

FIGURE 8-5









ization of production capacity, sugar recovery, base material costs, and the price of white sugar. Capacity utilization, as shown by Figure S-5, was recently running at around 95%. It has been as high as 130% and as low as 65%. Capacity utilization is affected by the length of the sugar campaign, the number of new plants coming on stream, and the quantity and quality of cane received.

The amount of sugar recovered per ton of cane processed depends on the quality of cane and the effectiveness of processing. Presently it is thought that cane quality is low in Pakistan because payment or special incentives are not made for sugar content. Payment is made on the basis of weight. The base material costs are largely cane, which depends to a large extent on the level of the support price, and the competition for cane between mills. The price of refined sugar depends on the sugar market and how effectively the Government of Pakistan imports in order to protect the ceiling price.

Based on the performance of publicly traded sugar processing companies the profitability of sugar processing is highly variable but usually runs around 15% to 20% of total capital employed. This does not appear large or small compared to other agricultural business firms. However, the returns are high enough to attract investment capital as demonstrated by the continued growth in constructed capacity. It also would not appear to justify public expenditure for subsidized investment loans.

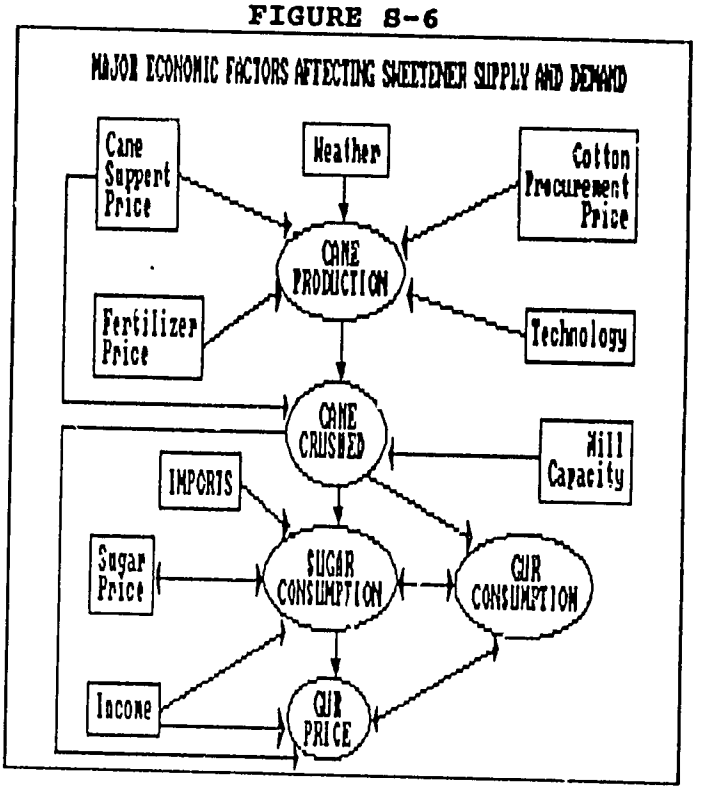
Pakistan Demand and Supply of Sweeteners

As noted earlier, sugar and gur and gur-like products make up almost the entire supply and consumption of sweeteners in Pakistan. The sweetener market reacts to the normal demand and supply factors but, due to government controls on sugar prices, gur production and prices have acted as the market's escape valve. The refined sugar industry in Pakistan has been subject to government intervention because of its importance to the growing urban market. These interventions have included price controls on refined sugar, control of the purchase and distribution of refined sugar to ration and Fair Price Shops, support prices for cane, and approval of investment in sugar processing capacity. Since 1984, controls on price and distribution have been lifted.

The government continues to intervene in the refined sugar market to insure the availability of sugar to consumers, promote price stability, and protect the domestic sugar industry. The primary instruments used to achieve these objectives are the level of import duties on refined sugar, direct import of sugar on public account and its sale at fixed prices through the Utility Stores Corporation.

As shown by Figure S-6, there are four major economic relationships that determine production and consumption of sugar in Pakistan. They include cane production, cane crush, sugar consumption, and gur price relationships. In the analysis carried out for this study, cane production is depicted as being determined by the cane support price which makes it more or less competitive with other crops as cotton, fertilizer prices that affect crop costs, and uncontrolled factors such as weather and technology. The amount of cane crushed is related to the amount of cane produced and the milling capacity as well as the price of cane, sugar and gur. During the period over which these relationships were observed, the sugar price was largely set by the government so sugar consumption, gur consumption and gur price were determined simultaneously at different levels of imports, sugar prices, and incomes. The relationships described here are all statistically significant over the 1962 to 1986 period. The sugar consumption relationship indicates a price elasticity for refined sugar of -.4 and income elasticity of .8 in nominal terms. This implies that relatively small changes in the supplies of sugar can cause more than proportional increases in sugar prices and that market prices in Pakistan will probably be unstable. It further implies that demand expands substantially as incomes improve. The gur price relationship indicates a price elasticity for gur of -.7 while the effect of income on gur consumption is not known.

FIGURE S-6



Policy Options

The sugar industry holds a relatively important position in agriculture, agribusiness and consumers' expectations. In agriculture, sugarcane is the second largest non-foodgrain crop after cotton. In agribusiness, sugar manufacture is second in total sales after textiles. To the consumer, sugar is an essential commodity like vegetable ghee or flour. Sugar shortages and increased prices trigger strong consumer reactions. Because of

the size of the sugar industry and its importance to the consumer, sugar is subject to a number of policies and government interventions.

Recently, the level of government intervention has declined with deregulation. Price and distribution controls on refined sugar were lifted and rationing abolished. The government monopoly on imports was replaced by a regulatory duty on sugar imports. The mill zoning system was discontinued. Finally, the sugar industry was removed from the list of Specified Industries for which investment sanctions are required.

In the wake of deregulation, three major and basic problems continue to be most evident. They include the question of maintaining self-sufficiency in sugar production, the problem of static sugar cane yields, restrictions resulting from the remaining regulations and the need for re-regulation.

What Level of Self-sufficiency Is Practical?

Attaining self-sufficiency in sugar production has been a formal but unobtainable goal of the Government of Pakistan for some time. In an effort to achieve this goal, the Government of Pakistan has maintained high sugarcane and sugar prices relative to other major sugar producing countries. This has been achieved through high support prices for sugarcane, regulatory duties on sugar imports, and excise taxes on sugar manufacture. The economic cost of this activity has been high sugar prices to the consumer. The economic benefit has been revenues to the government from regulatory duties and excise taxes. The foreign exchange advantage is not significant because the saving in imports of sugar is largely offset by the loss of cotton and wheat production with ensuing losses in exchange earnings from cotton exports and exchange savings from reduced wheat imports. Cane largely displaces cotton-wheat or rice-wheat crops. The economic costs and benefits as perceived in this study are summarized in Table S-1.

As shown by this table, the consumer costs of the sugar program are significant. Costs in this case are estimated as the difference between import plus distribution costs and the domestic retail price. Consumer costs of the program will vary from year to year and may even become a consumer revenue if world prices of sugar reach high levels.

The benefits of government revenues are also significant and represent an important form of taxation on a product which is not a large proportion of consumer expenditures. However, the tax is not especially efficient in the sense that it captures only half of the consumer cost. The remainder of the consumer cost goes to support cane and processing costs.

TABLE S-1

COSTS/BENEFITS OF THE CURRENT SUGAR PROGRAM

Year	Subsidy by Consumers[1]	Government Revenue		
		Import Taxes	Excise Duties	Total
	million rupees			
1985-86	6310	1161 [2]	2300	3461
1986-87	7155	2998	1800	4434

[1] Domestic sugar consumption multiplied by the difference between the domestic price and import cost of sugar adjusted for distribution costs.

[2] Estimated by multiplying the quantity of sugar imported by the unit import duty.

There are several proportions of self-sufficiency that might be achieved at different cost and risk levels. For example, the biggest risk is the potentially high price that might occur if imports were simply not available. For example if Pakistan were able to attain and hold an 80% self-sufficiency level and a world shortage foreclosed the availability of imports, Pakistan sugar prices would likely rise by 50%. If Pakistan held a 70% self-sufficiency level and imports were not available, prices could rise by 75%. Likewise, at 60% self-sufficiency and no imports, prices would likely rise by 100%. The level of self sufficiency that is maintained depends to a large extent on the level of risk that policymakers are willing to take. Also, higher prices will encourage the growth of artificial sweeteners from rice and corn negating the need for more sugar. These liquid sweeteners are particularly suitable for beverage making, fruit canning, and commercial baking. Other low calorie sweeteners such as saccharin and aspartame will likely develop for the less price conscious urban market.

Static Sugarcane Yield Problem

Besides imports, the key to increasing the Pakistan sweetener supply and consumption is through increased cane production. Both sugar and gur are based on sugarcane. Ten sugar mills have been built from 1979 to 1987 and sugar production has more than doubled during that period. However, total sweetener consumption per capita has remained constant or even declined somewhat because sugar production displaced gur production. Without other significant sources of sweeteners, it is important to continue the growth of sugarcane production.

As shown by Figure S-3, sugarcane yields in Pakistan have not trended upward since 1970. Nearly the entire increase in sugar production since 1970 has been due to increases in acreage. Consequently, without expansion in cultivated acreage, sugarcane replaces other crops. This adds another opportunity cost for increasing sugarcane production. Increasing production through augmented yields would involve using other inputs as seeds, fertilizer, pesticides and more intensive labor. This would not involve the displacement of other crops except where the added productivity improved net returns to sugarcane making it a more competitive crop.

In order to more adequately provide the needed technology to stimulate yield increases, an independent sugar research institute along with demonstration sites at mills could be implemented with little cost to the government of Pakistan and with some initiative from industry. By several accounts, the independent sugar research institute could be launched with Government of Pakistan sanctioning and financed by the sugar industry from the cane development cess fund. With industry funding, the sugar research institute would be independent and free of the environment of government bureaucracy.

Changes in land ownership regulations for mills would be required to make the research currently coming from government institutes and the independent sugar research institute available and effective. Sugar mills would need an exemption from the present ceiling on land ownership and allowed to own up to the size of several commercial farms, around 2000 acres. The additional acreage would be for the express purpose of model farms for demonstration, experimental plots and seed production. The model farms and the experimental plots would be used to adapt technology to local conditions from the independent sugar research institute and government institutes.

It should also be noted that as new technology is adopted, its full benefits can only be realized if the existing cane payment system is changed to one which rewards farmers for improving the sugar content of cane. Currently, growers are paid on the basis of weight and not the sugar content in the cane. The "quality

premium" currently paid by mills is similar to processors' profit sharing. The individual farmer does not receive an incentive to improve cane quality. There are practical difficulties in sampling and paying on the basis of cane sugar content to individual farmers, including technical difficulties with core samplers, and the large number of small growers who have to be paid. Nevertheless, an individual incentive is necessary to increase the yield of sugar per hectare.

Deregulation and Reregulation

Considerable deregulation of the sugar industry has taken place in the last five years, as discussed earlier. Despite deregulation, a number of regulations still impede the operation and development of the sugar industry. Most important is the location approval required for new mills. One proposal is to publish a "negative" list of areas where for important reasons sugar mills should not be set up. This would place the responsibility of site selection on the investor.

Another important set of regulations that disrupt the sugar production and marketing process are the tax exemptions available to sugar mills. These tax exemptions give new mills an advantage in acquiring sugarcane over older mills, but after some years the advantage is lost and market shares drift downward.

Besides government regulations, there is also a need to change bank lending policies for the sugar industry. The most notable of these is the need to regulate the levels of equity required for investment in the building of new capacity. Currently, the low level of equity required releases the investor from major responsibility to insure the success of the plant.

In the wake of deregulation, there is also a need for new regulations to improve and maintain competition. These include laws to prevent collusion on prices and market shares, legislation requiring content and quality labeling and warranting of products, and regulations to support fair trade practices. The problems associated with these types of regulations may not have manifested themselves in the sugar industry so far. However, experience in other countries shows that the absence of such regulations encourages market participants to behave in a manner which largely negates the benefits expected from deregulation.

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1.1 Introduction

In Pakistan, as in most countries of the world, sugar is considered by consumers to be a basic food. When basic foods are in short supply or the prices of such products are beyond the buying power of a large proportion of consumers, it is both a political and economic problem. Several major policy changes--decontrol and dezoning,to name two--have greatly impacted the sugar industry from farmer to consumer. It is in the environment of an industry adjusting to these many changes that this sugar industry study was undertaken. Previous studies have provided valuable information for evaluating the evolution of the industry.

1.2 Methodology and Scope of the Study

The objective of this study was to undertake an appraisal of the Pakistan sugar industry and develop a framework for evaluating alternative government policies. For this purpose, an econometric model of the sweetener sector was developed, which was used to examine the impact of alternative policies on consumer demand and domestic production. The relative merits of importing sugar or continuing to strive for domestic production to meet all of its sugar needs is an important question for Pakistan as well as for other countries. Although it is discussed at some length in the present report, time constraints did not allow for a comprehensive examination of this important issue. This shortcoming may be remedied by a study on the domestic resource costs of major crops in Pakistan which has recently been commissioned under the Economic Analysis Network Project.

The fructose sector has not been included in this study but it has potential to produce a major impact on the sweetener industry. This sector utilizes raw material that is storable and can be processed throughout the year. It may be a cheaper raw material than either cane or beets. Liquid sweeteners are preferred by some of the large commercial users who produce soft drinks, processed foods and confectionary. This type of sweetener has now taken over 50 percent of the total sweetener market in the US. There may be traditional patterns in Pakistan that reduce the threat presented by this sweetener to conventional sweeteners, but it must be considered as a factor in the sugar industry outlook.

The study team spent three weeks in the field in May 1987. This time was used in interviewing selected individuals considered to represent the points of view of different segments of the in-

dustry. Interviews were held with mill managers, large and small farmers, industry analysts and researchers, and government officials involved with the industry, loaning institutions, and trade organizations.

1.3 Background and Current Situation

The sugar industry in Pakistan has evolved from a relatively small base at the time of partition to its present status of importance in the agribusiness and agriculture sectors. Sugar plays a key role in satisfying human food wants, and the by-products of the industry further heighten its economic significance. As a cash crop, it is second only to cotton, and trails only textiles in order of importance in the processing sector. At the time of partition, only two mills operated in the area which is now Pakistan. These mills had a production capacity to crush only 1450 tons of cane per day. In 1987, there were 41 mills, with six mills to be added to this number within two to three years. These mills had an estimated production capacity of over 1.2 million tons of sugar per year.

Sugar is produced predominantly from sugarcane. The acreage under sugarcane has increased over fourfold during the past 30 years, from 189,000 hectares in 1948, to 802,000 hectares in 1987. It currently accounts for 3.9 percent of the total cropped area and 10.5 percent of the total value added for all crops in Pakistan. The Punjab province accounts for over half of the total cane produced although there has been a shift in production to the Sind in recent years. Sugarcane is produced by approximately 500,000 farmers, mostly small, as one crop among many others. Only in Sind are there large commercial farms specializing in cane production.

A feature of the Pakistan sugar industry is the existence of a large cottage sector which produces local sweeteners such as gur, shakkar and desi cheni from cane. These sweeteners are usually made by small cane growers themselves. Fructose production from maize or other raw materials is as yet unimportant, but is likely to grow as the consumption of soft drinks, confectionary and processed products expands. Both sugarcane and sugar production have stagnated in recent years after trending upward for over two decades, although there has been some recovery in the last two years. As a result, the gap between domestic production and consumption has widened and imports have risen. This is a matter of some concern since domestic sugarcane prices are already high relative to other sugarcane producing countries. At the same time, both sugarcane and sugar yields per hectare have been low and stagnant, resulting in high sugar production costs.

1.4 Industry Market Channels

The sugar industry is complex and dynamic. There are many actors in the industry who perform important functions as sugarcane and sugarbeet move through the market channels from the farms, are converted to sweeteners, and supplied in many forms to consumers. The flow chart presented in Figure 1.1 provides a simplistic overall view of these product flows and indicates the relative importance of different sectors.

It all starts on the farm. In 1985-86 almost 28 million metric tons of sugarcane was produced in Pakistan. Less than 45 percent of this was converted to white sugar by mills. The percentages are less in Punjab and NWFP and greater in Sind. The importance of the cottage sector is evident from the volume of cane (nearly 42 percent) processed into gur and other other local sweeteners. Gur production of nearly 1 million metric tons is estimated using an extraction rate of 10 percent and represents nearly half of Pakistan's sweetener supply. Gur products move from many on-farm, open-pan processors directly to consumers, as well as through retailers or wholesalers who assemble the products and distribute them. All sugarbeet is sold to mills and is processed for white sugar. Sugar produced from beets is only 1.3 percent of the total white sugar production.

At the present time mills sell almost all sugar to wholesalers or to large users (soft drink and juice processors, bakery and confectionary firms, etc.). There is little effort to differentiate products through branding and advertising consumer-size containers. Some movement toward branding and advertising has taken place since governemnt decontrol of sugar sales four years ago. Wholesalers purchase from mills in bulk and package into retail units for distribution through stores.

Consumers eat sugar directly or indirectly. The indirect consumption includes sugar in drinks, confectionary and all processed foods containing this product. Gur is consumed directly as well as in the form of local candies. Some gur is also used as livestock feed. Other sweeteners, such as liquid sugars, maize, and rice-based high fructose are consumed indirectly, in the form of manufactured or processed products.

The shortfalls in domestic sugar production relative to consumption each year are made up through imports or a drawdown in stocks (sugar held in storage from previous years). When domestic production exceeds consumption, as it has on occasion in past years, it goes into storage and stocks are increased. There are important by-products flowing from white sugar and gur production, the principal ones being bagasse and molasses. These are used in other industries or are exported.

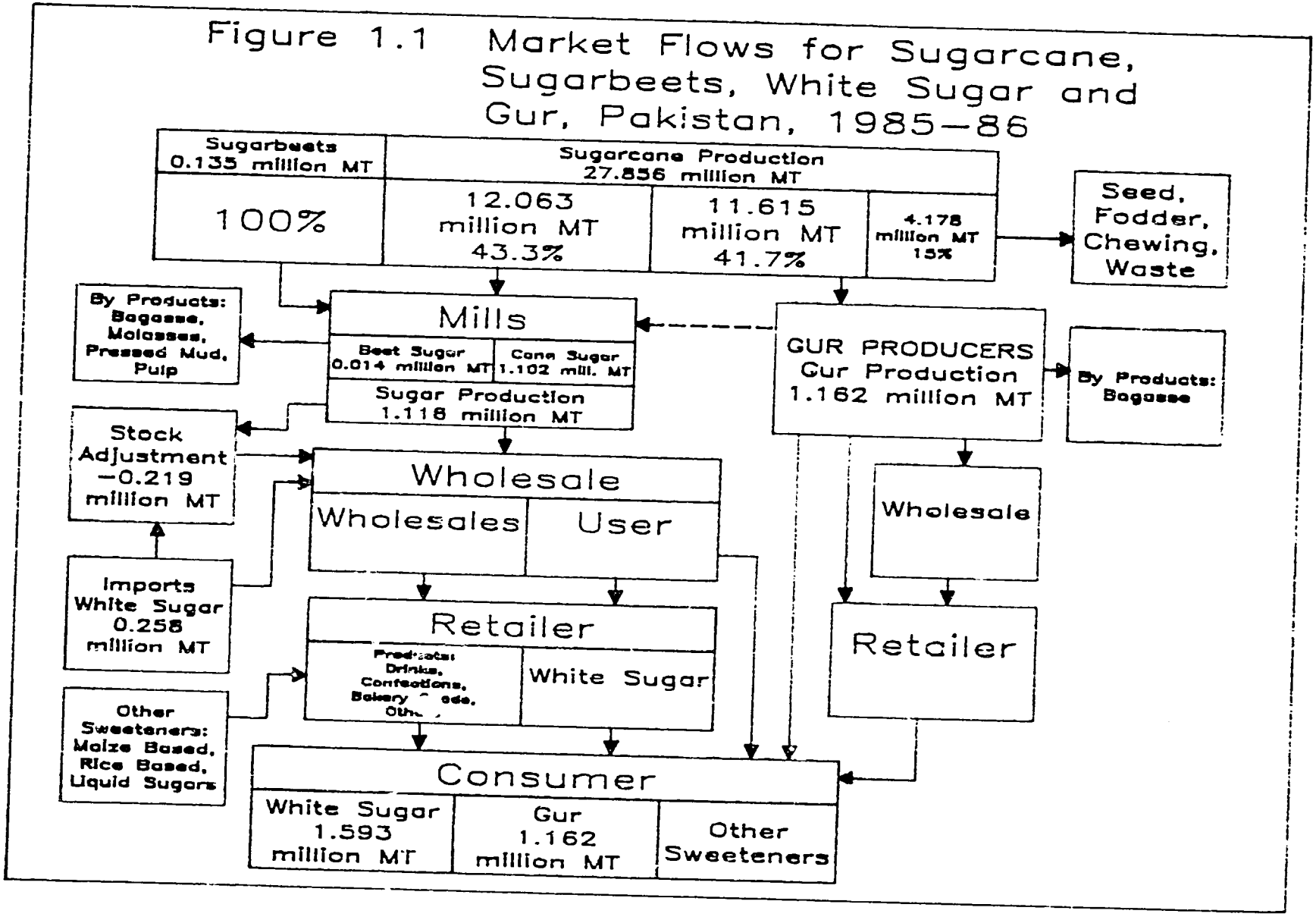


Figure 1.1 Market Flows for Sugarcane, Sugarbeets, White Sugar and Gur, Pakistan, 1985–86
Sugarbeets 0.135 million MT
Sugarcane Production 27.856 million MT
100%
12.063 million MT 43.3%
11.615 million MT 41.7%
4.178 million MT 15%
Seed, Fodder, Chewing, Waste
By Products: Bagasse, Molasses, Pressed Mud, Pulp
Mills
Beet Sugar 0.014 million MT
Cane Sugar 1.102 mil. MT
Sugar Production 1.116 million MT
GUR PRODUCERS Gur Production 1.162 million MT
By Products: Bagasse
Stock Adjustment −0.219 million MT
Wholesale
Wholesales
User
Wholesale
Imports White Sugar 0.258 million MT
Retailer
White Sugar
Retailer
Other Sweeteners: Maize Based, Rice Based, Liquid Sugars
Consumer
White Sugar 1.593 million MT
Gur 1.162 million MT
Other Sweeteners

1.5 Industry Sector Shares of Consumer Sugar Expenditure

In Figure 1.2, a scenario is presented for 1000 kilograms of sugarcane produced and the product values as the cane is marketed, processed and the extracted sugar is moved to consumers. It begins on the farm with the cutting of 1000 kilograms of sugarcane. If this cane could be processed within 1-2 hours, as some production areas in the world try to accomplish but seldom succeed in doing, there would be no loss of weight or sugar content and the scale weight would be 1000 kilograms. However, it usually takes at least 10-15 hours time to transport and wait for unloading before the cane can be weighed. During this period the cane loses weight due to moisture evaporation (and perhaps some sucrose inversion so that extraction is less). The weight loss is assumed to be 2 percent, which may be a conservative estimate relative to real world post harvest losses in Pakistan. The farmer is paid for 980 kilograms of sugarcane. The value of this cane is Rs. 294 at a price of Rs.12 per 40kg. If the cane could have been processed without weight loss the value would have been Rs.300. The opportunity cost to farmers from long delays in loading, transporting and waiting can be clearly demonstrated as higher weight losses occur the longer the delay in weighing the cane at the mill. Delays also result in large losses to mills from reduced sugar production per maund of cane processed.

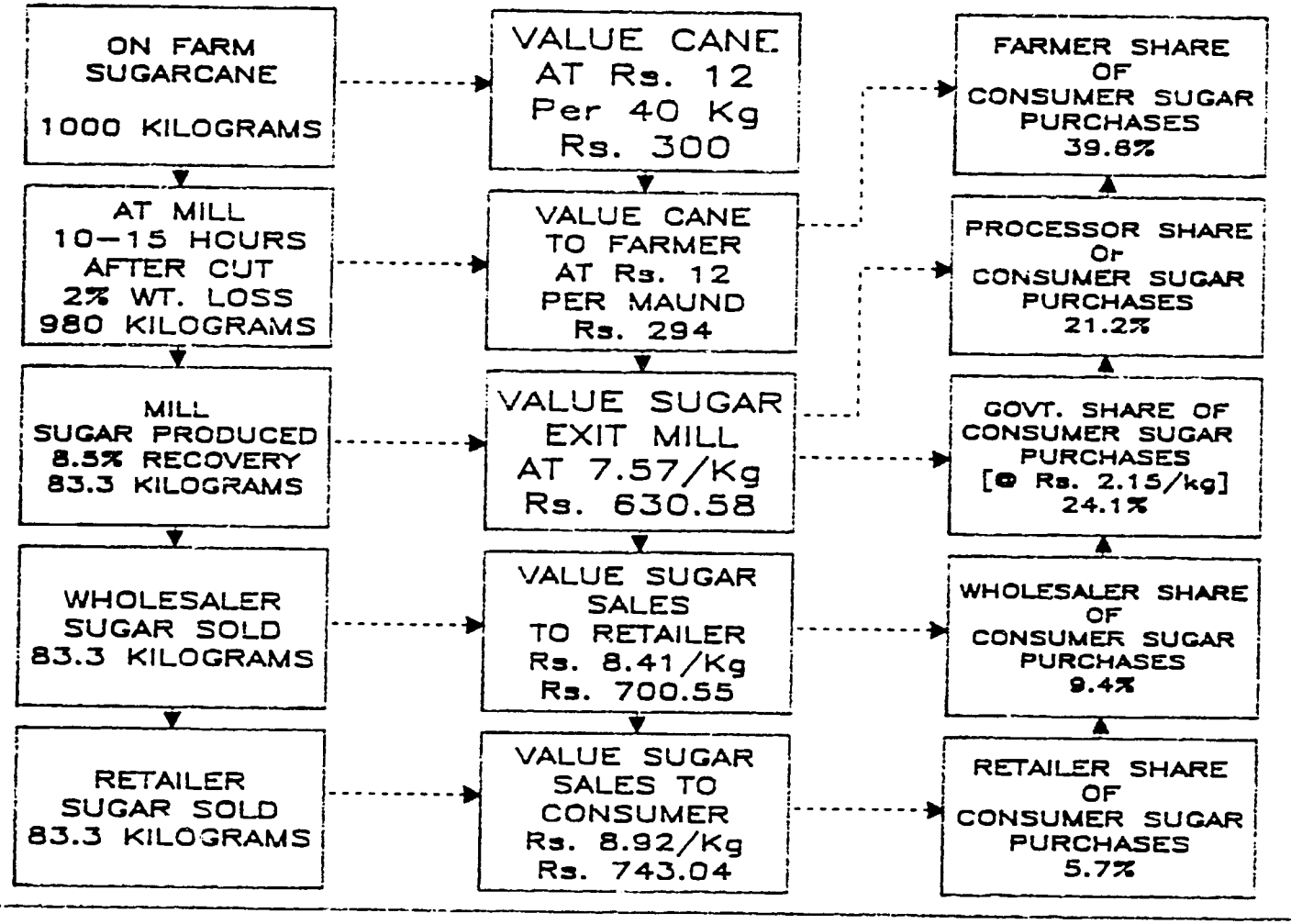
The sugar produced is assumed to be 8.5% of the cane weight. This percentage varies by mill, area, and time of harvest. The sugar produced from the 980 kilograms of cane received by the mill is 83.3 kilograms which has a value of Rs.630.58 when sold at an exit mill price of Rs.7.57 per kilogram. This includes excise taxes of Rs. 2.15 per kilogam levied on sugar production which are carried through the system to the final consumer.

Mills sell to wholesalers who break the bulk amounts of sugar into consumer size lots for sale to retailers. They purchase at the exit mill price and resell to retailers at the wholesale price which is Rs.8.41 per kilogram in this example. The value of the 83.3 kilograms of sugar now becomes Rs. 700.55. The gross returns to this sector is the difference in purchase and sales values.

Retailers sell to consumers at the retail price Rs.8.92/kg. The gross returns of this sector is the difference between wholesale value and the value of sales to consumers.

One measure of evaluating the performance of different sectors of an industry is to compute the share of consumer expenditures that flow to each sector and the associated functions that are performed by each sector. In Figure 1.2, the set of boxes on the right reveal that farmers receive about 40% of consumer expenditure for white sugar, processors receive 21%, and the shares

Figure 1.2 Estimated Product Values and Market Shares by Sectors for 1000 Kilograms of Sugarcane, Pakistan 1985–86



of wholesalers and retailers are around 9% and 6%, respectively. It is noteworthy to observe that about a quarter of all expenditures for sugar flow directly to the public sector. To the extent that this revenue, collected by the government, is used in improving the quality of life for the population, the spending is returned to the consumers. Since a detailed analysis of each sector would be required to determine whether or not each sector is performing functions deserving of the margins absorbed by it, this study did not deal explicitly with such questions.

1.6 Organization of the Report

The rest of the report is organised as follows. Chapter 2 describes the farm sector and summarizes trends in sugarcane and sugarbeet acreage, production, and yields. The major determinants of cane production are identified. Then, using a relationship based on an earlier study done by Chemonics, projections of cane production are made under alternative policy scenarios. At the micro level, linear programming analysis is used to determine the profit maximizing solution to crop selection as different constraints and input costs or prices are varied. The major factors affecting the allocation of cane output between supplies to sugar mills and alternative uses are also discussed in this chapter.

Chapter 3 focuses on the processing sector. In this section, sugar processing costs are estimated and related to mill profitability. The major policy issues affecting the processing sector are also discussed. An overview of the world sweetener market is provided in Chapter 4 in which recent trends in sugar consumption, production, and prices are discussed.

Chapter 5 contains an analysis of the supply and demand for sweeteners in Pakistan. A model of the sweetener sector is developed which is used to make projections of sweetener supply and demand under alternative scenarios. The chapter concludes with a discussion of the policy implications of the supply and demand analysis.

In Chapter 6, the major government regulations affecting the sugar industry are described. This is followed by an examination of the sugar policymaking process in Pakistan. The final chapter brings together and summarizes some of the important policy questions raised in various parts of the report.

2. THE FARM SECTOR

2.1 Introduction

Sugarcane is essentially a crop of the tropics. For ideal growing conditions, it requires a humid climate, well-distributed rainfall and stable temperatures. But Pakistan, which in terms of acreage under sugarcane ranks fifth in the world, lies outside the tropics. This has two consequences. First, due to the existence of extreme temperature ranges, the growing season for cane in Pakistan is relatively short-- 8 to 12 months, as compared to 12 to 24 months in other cane growing countries. Most cane is planted in spring and harvested between November and April. Second, cane cultivation depends heavily on irrigation and a shortage of water can affect cane acreage and output considerably. Pakistani farmers have been known to plough up the crop in years of severe water shortages.

With the exception of Sind, most of the cane in Pakistan is grown on small holdings, often less than 2 acres in size. Ratooning is a common practice and farmers usually grow one or two ratoon crops. More than half of the sugarcane acreage in any year is estimated to be a ratoon crop. Farmers often intercrop cane with wheat, potatoes, beet, and fodder crops.

Sugarcane, for the most part, is harvested about 12 months after planting. At harvest, the cane is cut off near the ground with a heavy knife. In rare cases machines are used for cutting. The plant is then stripped of its leaves and packed tightly onto ox and tractor carts to be shipped to the sugar mill. Sugarcane used for gur making is usually moved by hand or oxcart from the field to the farm press. On occasion the leaves as well as the crushed stalk are used to provide the heat for the open pan boiling of the juice.

At the mill, cane is sold on the basis of weight. This is an unusual practice. In most sugarcane producing countries cane is sold on the basis of estimated sugar content. In some countries the price is even adjusted for purity of sugar content.

Plant husbandry practices for sugarcane in Pakistan have been established for many years and are practical for the "home" production of gur but not necessarily for refined sugar. For the most part, gur making is a supplemental enterprise using otherwise unused labor and animal power. Sugarcane husbandry in Pakistan is thousands of years old. One of the officers of Alexander's invading army discussed sugar around 325 B.C. Perhaps sugarcane had been growing in Pakistan several centuries earlier. In this century, and especially since independence, sugarcane has become one of the four major field crops (wheat, cotton, rice and sugarcane)

of Pakistan. As a major field crop sugarcane competes, on the basis of its returns, with other crops, especially cotton, for acreage.

Pakistan is one of the few countries in the world which grow sugarbeet as well as cane. Sugarbeet is grown mainly in the cooler northern parts of the country. It is grown during the winter and spring months and is harvested in May and June at the end of the cane crushing season. This is in contrast to the practice of beet-producing countries in the northern hemisphere where the crop is grown during summer and autumn and is harvested in October. Sugarbeet is often intercropped with sugarcane in Pakistan.

2.2 Sugarcane Supply

2.2.1 Long Term Trends in Sugarcane and Sugarbeet Production

Since independence, the area under sugarcane has expanded more rapidly than any other major crop in Pakistan. Between 1948 and 1987, sugarcane acreage increased by about 4% per year and its share of total cropped area rose from 1.6% to 3.9%. The expansion of the area planted to cane occurred in response to high support prices for cane and expansion in mill capacity. High support prices made sugarcane more profitable relative to other crops while the expansion in mill capacity provided a market for the increased production.

As Figure 2.1 shows, the growth in cane acreage seems to have followed a distinct cyclical pattern. The typical cycle has been a four-year one with acreage falling in successive years after rising in the previous two years. This is mainly due to the practice of ratooning which in Pakistan usually involves one plant crop and two ratoons. As a result, planting decisions in one year have an impact on the cropped area in the following two to three years. Since 1982, the area under sugarcane has declined consistently due to drought, low power availability to operate tubewells, and static cane support prices.

Trends in sugarcane production have closely mirrored those in acreage (Figure 2.2). During the period 1948-87, sugarcane production grew at an annual average rate of 4.8%. Growth in production, however, has been much slower over the last two decades than in the past (see Table 2.1). Since 1982, cane production has, in fact, declined by over 4% per year though there appears to have been some recovery in 1987 and 1988.

Most of the increase in sugarcane production has been due to an expansion in area with little or no improvement in yields. As Figure 2.3 shows, sugarcane yields have stagnated since the mid 1960s.

FIGURE 2.1 PAKISTAN SUGARCANE ACREAGE, 1948-87

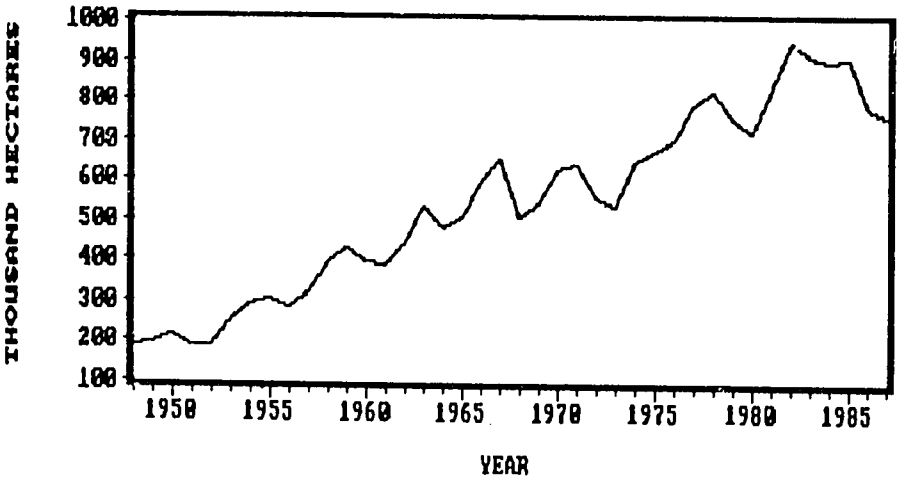


FIGURE 2.2 PAKISTAN SUGARCANE PRODUCTION, 1948-87

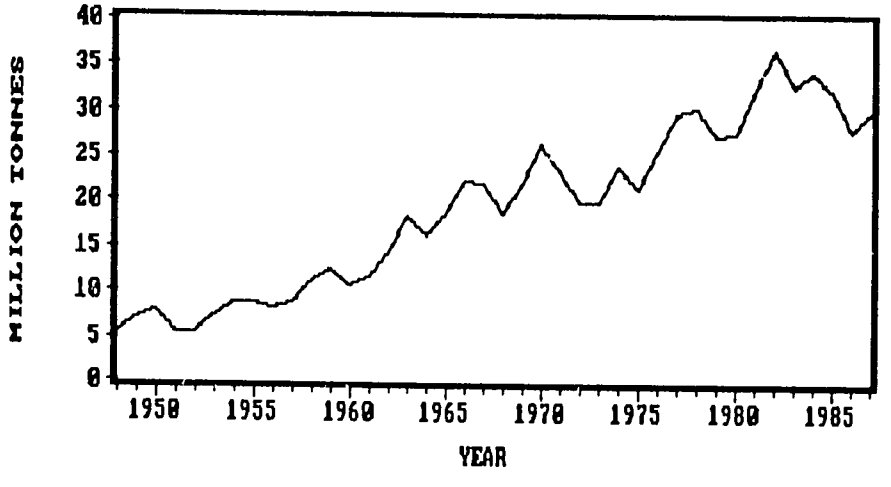


FIGURE 2.3 PAKISTAN SUGARCANE YIELDS, 1948-87

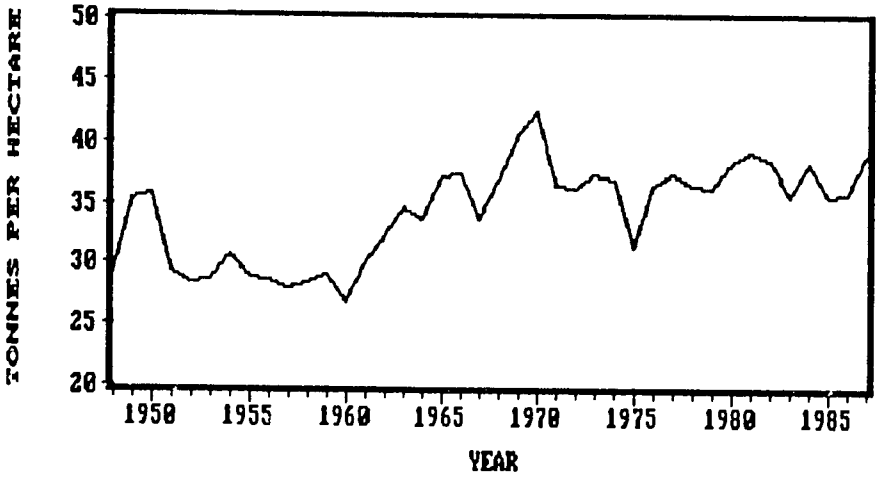


TABLE 2.1 ANNUAL GROWTH RATES OF SUGARCANE ACREAGE, PRODUCTION AND YIELDS [1]

PERIOD	ACREAGE		PRODUCTION		YIELD	
	Rate(%)	R-squared	Rate(%)	R-squared	Rate(%)	R-squared
1948-87	4.1	0.90	4.8	0.89	0.7	0.48
1948-70	6.0	0.92	7.2	0.92	1.2	0.38
1970-87	2.5	0.63	2.5	0.55	-	-
1982-87	-4.3	0.83	-4.2	0.72	-	-

[1] Growth rates have been computed by regressing the logarithm of the series on time.

Punjab accounts for 66% of the acreage under sugarcane and 64 % of total production. Much of the recent increase in cane acreage and output, however, has been in the province of Sind (see Appendix A, Table A1). Between 1970 and 1986, Sind's share of total cane production increased from 13% to 27%. The emergence of Sind as a major cane producing area has been due mainly to favorable climatic conditions which are reflected in the relatively higher yields per hectare obtained in that province. The share of both the Punjab and NWFP in total acreage and production has declined over time.

Sugarbeet is a more recent crop for Pakistan. Its commercial cultivation began in the early 1970s. Sugarbeet is grown almost exclusively in the NWFP and remains largely insignificant at the national level. Statistics on the acreage, production, and yields of sugarbeet are presented in Table 2.2.

There appear to be no statistically significant trends in sugarbeet acreage, production, or yields over the period 1972-85. However, beet acreage and production fell by over two thirds from 1982 to 1985 due to low support prices and a lack of interest on the part of sugar mills to process beet because of its high processing cost. Beet production is reported to have recovered from its extremely low levels since the government raised its minimum support price and exempted sugar produced from beet from excise taxes.

TABLE 2.2 AREA, PRODUCTION AND YIELD OF SUGARBEET IN PAKISTAN. 1972-85

FISCAL YEAR	AREA (000 Hectares)				PRODUCTION (000 M.Tons)				YIELD (M.Tons/hectare)			
	Punjab	Sind	NWFP	Pakistan	Punjab	Sind	NWFP	Pakistan	Punjab	Sind	NWFP	Pakistan
1972	(a)	0.1	6.4	6.5	0.1	0.3	131.3	131.7	-	4.5	20.4	20.3
1973	0.1	0.1	12.0	12.6	2.8	0.4	256.6	259.9	5.5	6.0	21.4	20.6
1974	0.1	0.1	10.4	10.6	0.8	0.3	334.4	335.5	6.0	5.4	32.2	31.7
1975	0.1	(a)	9.7	9.8	1.4	0.1	236.8	238.3	9.8	-	24.5	24.3
1976	-	(a)	10.3	10.3	-	0.1	272.7	272.8	-	-	26.4	26.5
1977	(a)	0.7	13.4	14.1	0.3	7.6	381.5	389.4	-	11.2	28.6	27.6
1978	0.8	(a)	13.7	14.5	13.9	0.2	312.7	326.9	18.2	-	22.8	22.5
1979	-	(a)	14.0	14.0	-	0.2	334.4	334.6	-	-	23.8	23.9
1980	(a)	(a)	13.2	13.2	-	0.3	339.0	339.3	-	-	25.7	25.7
1981	-	(a)	15.7	15.7	-	0.3	452.2	452.5	-	-	28.8	28.8
1982	-	0.1	12.4	12.5	-	0.4	360.0	360.4	-	8.1	29.0	28.8
1983	-	(a)	8.7	8.7	-	0.3	205.9	206.2	-	8.3	23.8	23.7
1984	-	0.1	8.2	8.2	-	0.4	178.0	178.4	-	8.3	21.7	21.8
1985	-	0.1	3.7	3.8	-	0.4	103.1	103.5	-	8.2	27.5	27.2

(a) Less than 500 hectares

Source : Ministry of Food and Agriculture

2.2.2 Major Factors Affecting Sugarcane Production

The causes for changes in sugarcane area, and to some extent yields, appear to be related to economic phenomena, as well as biological and weather related factors. More specifically, the production of sugarcane has been associated with the prices of sugarcane, cotton, and fertilizer, with technology gains, and the habit of producing sugarcane.

Higher sugarcane prices increase the returns to sugarcane and encourage producers to plant additional hectares of the crop and use additional inputs such as fertilizer, pesticides and soil cultivation to increase yields. Increased prices of cotton encourage the use of more land (and field inputs) for cotton, that would otherwise be used for sugarcane. Higher prices of fertilizer reduce the returns to sugarcane growing and discourage producers from using fertilizer causing reduced yields. Over the longer term, technology advances in the use of inputs such as seeds, and cultivation techniques, tend to support a gradual trend increase in yields and total production. Finally, it should be noted that there is a tradition of sugarcane production in Pakistan, for household consumption as gur and increasingly as a

cash crop to be sold to sugar mills. These factors were related to sugarcane production in a study for Chemonics by Dr. Mubarik Ali (Ali, 1987). The specific relationship that was developed is as follows:

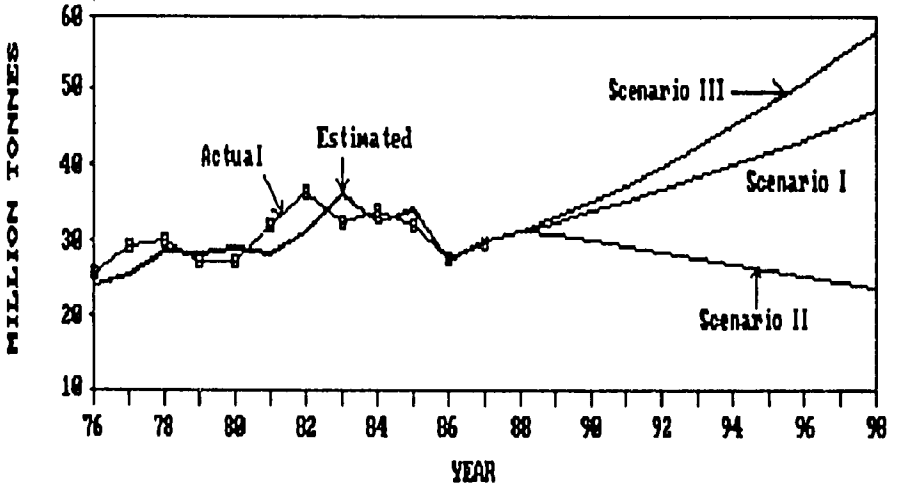
$$CQ = 4751*COTP^{-.201}*CPR^{.530}*NITP^{-.238}*CQ_{t-1}^{.242}*1.029^{T}$$

Where:

CQ = Total sugarcane production in thousand metric tons.
COTP = The price of seed cotton (Phutti) in rupees per 40 Kg.
CPR = The support price for sugarcane in rupees per 40 Kgs.
NITP = The price of nitrogen in urea, Rs. per 50 kgs of nitrogen.
CQ_{t-1}= Total sugar cane production in the previous year in thousand metric tons.
T = Time trend variable for technology improvement beginning with 30 in 1985/86.

According to the relationship outlined above, future trends in sugarcane production will depend upon (a) movements in the prices of sugarcane, cotton and fertilizer, all of which are currently set by the GOP, and (b) the trend rate of growth embodying technological improvements over time. Figure 2.4 shows sugarcane production over the next two five-year planning periods under three different scenarios.

FIGURE 2.4 ESTIMATED SUGARCANE PRODUCTION, 1976-98



The constant term has been adjusted for the years 1986 and 1987 to ensure that the level of estimated sugarcane production at the beginning of the projection period matches actual production. Under the first scenario, it is assumed that sugarcane and cotton prices increase by 6.1% and 3% per annum, the average rate at which they have increased over the past ten years. Nitrogen fertilizer prices increase by 7.5% annually reflecting higher import prices and domestic manufacturing costs. In this case, the supply relationship predicts that sugarcane production grows by about 4.2% per annum over the next ten years. The increase in production, under this scenario is almost entirely dependent upon continuation of the trend rate of growth representing in part technology advances. If the trend rate of growth is assumed to be zero, sugarcane production stagnates at current levels.

Under the second scenario, sugarcane prices are held constant while the support price of cotton increases at about 3% per annum. Fertiliser prices increase by 7.5% per year. It is assumed that the trend rate of growth in sugarcane production does not continue. In these circumstances the supply relationship predicts a decline in sugarcane production of 2.8 percent per year from about 31 million tons in 1988 to nearly 24 million tons in 1998. The increase in the support price of cotton relative to sugarcane encourages a shift of acreage out of sugarcane. At the same time higher fertilizer prices reduce the returns to sugarcane cultivation. The result is a continuous decline in sugarcane production over the next 10 years.

The third scenario depicts a situation in which sugarcane prices increase much more rapidly than those of cotton. While cotton prices increase at 3% per year, sugarcane prices increase by 10% annually. Fertiliser prices are again assumed to rise by 7.5% per year. Under this scenario the supply model predicts a growth in sugarcane production of about 6.4% per year over the next two five-year plan periods. Higher sugarcane prices relative to other crops (cotton) and input (fertilizer) costs encourage additional production.

The scenarios drawn above show the dependence of sugarcane production upon its own price, the prices of cotton and fertilizer, and yield-increasing technological improvements. Since fertilizer prices are for the most part given and technological advances difficult to achieve, sugarcane and cotton prices represent the principal means by which the GOP can influence sugarcane production in the short run.

Projections based on the supply relationship outlined above indicate that if sugarcane and cotton prices continue to increase as they have over the last ten years, cane production will grow at a rate somewhat higher than that of population. However, if the trend rate of growth in cane production, representing in part technology advances, does not continue, production will stagnate.

On the other hand, if sugarcane prices are held constant and cotton and fertilizer prices are allowed to rise, then sugarcane production will decline steadily over the next ten years. If sugarcane production is to keep pace with the growing demand for sweeteners fuelled by both population growth and increasing incomes then sugarcane prices will have to rise at a significantly faster rate than cotton prices. This is especially so since recent increases in cotton yields have tended to make cotton more competitive even when relative prices remain unchanged.

2.3 Costs of Production

The eventual cost of producing sugar is largely determined by sugarcane yields, the sucrose content of cane, and sugar processing costs. As noted earlier, sugarcane yields in Pakistan are among the lowest in the world compared to other major sugarcane producing countries for which data are presented in Table 2.3.

TABLE 2.3 SUGARCANE YIELDS IN MAJOR CANE PRODUCING COUNTRIES, 1982

Country/ Region	Tonnes/ hectare
India	57.5
Brazil	58.2
Cuba	48.3
China	58.1
Thailand	52.8
Philippines	50.0
USA	88.5
Australia	80.9
Columbia	87.7
Pakistan	38.6

Source: "Inter Country Rank-Basic Data on Agriculture," Agricultural Development Bank of Pakistan from FAO Production Yearbook, 1982

Pakistan's results are somewhat less negative when it is noted that cane occupies the land for only 8-12 months when spring planted, compared to 12-18 months for other cane growing countries. The total revenue generated from a given acreage, over a five year period, may be a more accurate measure of productivity. Even then, average yields in Pakistan are low relative to other countries and there is much room for improvement.

It would be interesting to compare sugarcane production costs in Pakistan with other developing countries which export sugar and use considerable hand labor. However, this information was not available at the time of this study. If Pakistan wishes to export, it will be in direct competition with these latter countries and with countries that subsidize farmers and dump surplus sugar on the world market. These countries set the base from which Pakistan's producers and processors need to be subsidized or protected by other means in order to have a viable industry.

Pakistan sugarcane production costs, together with the underlying technical coefficients, are shown in Appendix A, Tables A-2 - A-4.

2.4 Reasons For Low Sugarcane Yields and Low Sugar Content

The major problems of the sugarcane sector in Pakistan are low sugarcane yields and low sugar content of cane. These result in high sugarcane and sugar production costs. This section describes some of the main factors contributing to low productivity and low sucrose content of cane.

Based on interviews with industry experts and on existing literature, a list of factors causing low sugarcane yields is given below:

(a) Climate and natural disasters

Climatic conditions in Pakistan are not regarded as ideal for cane production. Because of the extremes in temperature, the growth season is limited and does not permit adequate time for optimum photosynthesis. Susceptibility to natural disasters such as drought and (in the NWFP) frosts further serve to reduce yields. The Punjab has been faced with drought the past two or three years.

(b) Lack of high yielding varieties

Minimal support has been given by both the government and industry to improve cane varieties adapted to Pakistan. This is in contrast to the position found in other major crops such as cotton, rice and wheat, where improved varieties have increased the per acre productivity of these crops.

(c) Small farm agriculture

Small farms are a major source of sugarcane in both the Punjab and the NWFP. These farms tend to apply few critical purchased inputs such as fertilizer and pesticides or they

do not apply them at the appropriate time. Small farmers also do not give much attention to their ratoon crop and tend to regard it as a "free" crop.

(d) Disease and pests

Disease outbreaks and pest attacks have reduced yields in many years. They have also increased the cost of production to combat these problems. In some areas of NWFP, cane production has been abandoned because of termite problems. Late harvesting of cane in the hotter months of April, May and June is also reported to increase pest infestation problems.

(e) Shortage of irrigation water

Sugarcane is a highly water-intensive crop. Shortages of irrigation water result in inadequate watering and reduce yields.

(f) Poor siting of sugar mills

Some sugar mills have been established in areas not suitable for sugarcane cultivation. This has resulted in lower yields than obtained on average.

(g) Lack of extension

Both government and industry extension services to assist producers to improve yields by adopting better cultivation practices, higher fertilization etc, are weak or non-existent.

Factors which contribute to low yields also cause low sucrose content. There are also, however, additional factors that contribute to the low sucrose content of cane. These are listed below:

(a) Planting time

There are critical periods in which cane should be planted--sometimes within a 15-20 day period. Planting may be delayed by crop rotation considerations, canal closure, or lack of suitable implements to prepare the soil properly. In Sind, fall planting can be used to increase both yields and sucrose content. However, relatively few farmers follow this production practice at the present time.

(b) Time of harvest

Sugar recovery is higher in March than in November or May. The crushing capacity limits of mills, however, constrains the harvest time, and harvesting must be distributed over the total crushing period.

(c) Post harvest losses

Frequently, there are long periods between harvest and the time cane is crushed. In 24 hours cane can lose upto 2.5% of its weight and the extraction percentage of sugar is also reduced. Delays in crushing are caused by long waiting periods to unload at mills, long harvest time (the time taken by a family to cut a full load of cane), long distance hauling, and dumping at collection centers requiring additional time to re-load and haul cane to the mill.

(d) Cane payment by weight

When weight is the only criterion for pricing sugarcane it is a direct punishment for growers to improve sugar content. For example, sugarcane that has a high sucrose content attracts insects, pests, and wild boar more than does less sweet cane. This requires additionl costs to combat these invaders. Farmers can reduce these costs by producing a less sweet cane and receiving the same price for the commodity from the mill. Producers can also increase the weight of cane by irrigating relatively near harvest. Sugar content is enhanced if cane is is not irrigated several weeks prior to harvest. Irrigating just prior to harvest or near harvest significantly reduces sugar content. There is no price incentive to discourage this practice although mills may reject the cane if it is too obvious that late watering has been practiced. Nitrogen application near the ripening stage encourages leaf and stem growth rather than sugar production. More liquid and weight is retained in the cane under these conditions. However, since weight, not sugar content, is important to the grower, there is the temptation to apply fertilizer later than should be done.

2.5 Production Alternatives: Whole Farm Analysis

2.5.1 Preliminaries

Farm level production decisions are based upon a number of factors, such as the relative profitability of crops which can be grown on the farm, the fixed resources available with the farmer, the availability of capital to buy cash inputs, the physical and institutional infrastructure that guides production deci-

sions, and the overall structure of economic incentives provided to farmers. In Pakistan's cropping systems, a number of crops compete with sugarcane for available fixed and variable farm resources. As a matter of fact no other crop has as many competing crops as sugarcane, mainly because its growing season lasts a whole year. This section analyzes the financial viability of sugarcane production in a whole farming context.

First, financial returns from selected crops are compared to determine their relative profitability. Then, a linear programming model is developed to analyze the impact of input-output price changes and technological developments on sugarcane production. The model is also used to explore questions relating to efficiency of sugarcane growers in a selected study area.

The farm model developed in this study represents average farming conditions in the Pakpattan area of Punjab province. This area represents cropping systems followed in mixed cropping zones--where wheat is an important rabi crop while cotton and rice compete with each other in the kharif season. However, over the years, cotton has emerged as a dominant crop in the kharif season. Sugarcane occupies an important place in the cropping pattern (about 12 percent of the total cultivated area in each season) and competes with all leading rabi and kharif crops.

Another reason for modelling Pakpattan area was that data with respect to input use, cropping pattern, cropping intensity, output of crops, supply and demand of irrigation water, and availability of farm resources were readily available. The data were collected by the Water and Power Development Authority (WAPDA) in 1983 for preparation of a feasibility report for the Command Water Management Project (CWMP). The crop budget and farm income analysis is based on 1987 financial input-output prices, adjusted to farmgate level. Prices used in the estimation of production costs and income of different crops, levels of input usage, per acre output, and other relevant assumptions are shown in Appendix A, Tables A2 to A6. Most of the sugarcane produced in this area is supplied to a local sugar mill.

2.5.2 Crop Profitability Analysis

Profitability analysis can be conducted in many ways but the enterprise budget approach is considered to be most appropriate as it accounts for every input in detail. Crop returns are presented in terms of net income because this captures the effects of differences in input usage levels (on the cost side) and yield per acre and price of output (on the income side). The crop returns reflect the financial viability of farmers growing these crops under the range of conditions set forth.

As shown in Table 2.4, net income is defined in three different ways. In cases 1 and 2, all cash and non-cash costs are included except that land has been valued differently. In the first case, land is valued on the basis of prevailing market rent; while an opportunity cost measure is used to value land in the second case. The third case accounts only for the cash production costs. This method implicitly assumes that the opportunity cost of farm resources and other non-cash inputs is zero.

TABLE 2.4 FINANCIAL NET RETURNS FROM DIFFERENT CROPS IN PAKPATTAN AREA, PUNJAB PROVINCE, 1987

Crops	Case 1	Case 2	Case 3
	----------Rupees per acre ----------		
Rice (Irri)	-709.84	-403.59	766.08
Rice (Basmati)	-474.88	-168.63	1003.77
Cotton	510.04	816.29	1945.09
Kharif fodder	-267.52	38.73	539.80
Maize	-549.43	-243.18	675.57
Sugarcane	-102.78	509.72	2472.94
Orchards	1097.25	1709.75	3145.25
Wheat	-234.59	71.66	1181.55
Oilseeds	-189.38	116.87	968.10
Rabi fodder	904.18	1210.43	2214.20
Vegetables	553.66	859.91	1703.66

Source: Appendix A, Tables A2-A4.

Net income for all crops is higher under case 3 followed by that under cases 2 and 1, respectively. The profitability ranking of various crops stayed the same under the first two cases because the difference in land rent remained constant over all crops. However, the crop ranking was somewhat different under case 3 because of differences in cost and income parameters. Negative net returns in cases 1 and 2 do not necessarily imply a financial loss to the farmer. As a matter of fact, the negative returns are a result of the dominance of family and bullock labor in the production functions. This implies that the farmer would not, in fact, be able to compensate family labor and bullock labor at the wage levels assumed in the analysis.

Crop profitability analysis under the cash flow method (Case 3) indicates that fruit orchards and sugarcane are the most profitable crops. However, the net returns for these crops correspond to a full year growing season; whereas the growing season for other competing crops lasts for roughly six months.

Seasonal fodders are grown on the farm only to meet the fodder requirements of livestock since no regular fodder market exists in the rural areas. Farmers do not bring much area under vegetables because it is a labor intensive crop and perishable in nature. An insecure market, and transportation problems, are some other factors which discourage farmers from growing these crops. Of the remaining crops, cotton yields the highest net returns per acre followed by wheat, rice (basmati), oilseeds, rice (IRRI) and maize. The net return analysis confirms the rationality of farmers as cotton and wheat dominate the cropping pattern in the kharif and rabi seasons, respectively.

2.5.3 Farm Income Analysis: the Model

A farm planning model of standard linear programming (LP) format was used to analyze the impact of various policy and technological parameters on farm income in general and sugarcane production in particular. The standard form of the model is:

$$\begin{aligned} &\text{Max (or Min)} && z = cx \\ &\text{subject to} && ax \leq b \\ &\text{and} && x \geq 0 \end{aligned} \qquad [1]$$

where the objective function (cx) is designed to maximize net returns to management subject to the technical constraints of the production function and the level of resource availability (b). The typical element aij of the technology matrix (a) represents the amount of input i required per unit of output j.

The model considers four types of activities: production of crops and livestock, sale of output and by-products, feeding of farm animals through production of fodder and crop residues, and purchase of inputs. Crop production was assumed to take place over a broad range of irrigation regimes, ranging from non-stressed production to highly stressed production in response to evaporation deficits. Water response functions developed by Chaudhry (1985) are used in this study.

Fixed resource constraints are land, canal water, and family labor. The present model represents a farm size of 20 acres. The land constraint is expressed on a seasonal basis while water supply and its use is expressed on a monthly basis. Labor is also expressed on a seasonal basis with a total of 2800 hours of labor assumed to be available in each season. The acreage of certain perishable and high valued crops (vegetables and fruit orchards) has been restricted to a predetermined level to avoid their

dominating the solution. The upper limit for these crops corresponds to the observed acreage in each case. The number of livestock on the farm is restricted to the typical existing holding. The model provides the required amount of TDN and DP to these animals via production of seasonal fodders and crop residues. The details with respect to activities, constraints and technical coefficients used in the programming model can be found in Chaudhry (1985).

In order to test the validity of the model, the results generated by it are compared with the survey results compiled by WAPDA and the historical cropping pattern of Pakpattan area (Table 2.4). The predicted cropping intensity turned out to be almost the same as the historical cropping intensity reported for the area. However, the model predicted more area under wheat than is reflected in the historical cropping pattern. Also, the model did not predict any area under oilseeds while the historical cropping pattern showed nearly 5% of the total cultivated area under this crop. It is very likely that favorable output prices for wheat in recent years might have diverted some of the oilseeds acreage to wheat. The presence of some farmers specializing in oilseed production in the project area could have been another reason for this crop having shown up in the historical cropping pattern.

TABLE 2.5 COMPARISON OF LP MODEL RESULTS WITH HISTORICAL CROPPING PATTERN AND SURVEY RESULTS

(Percent of Cultivated Area)

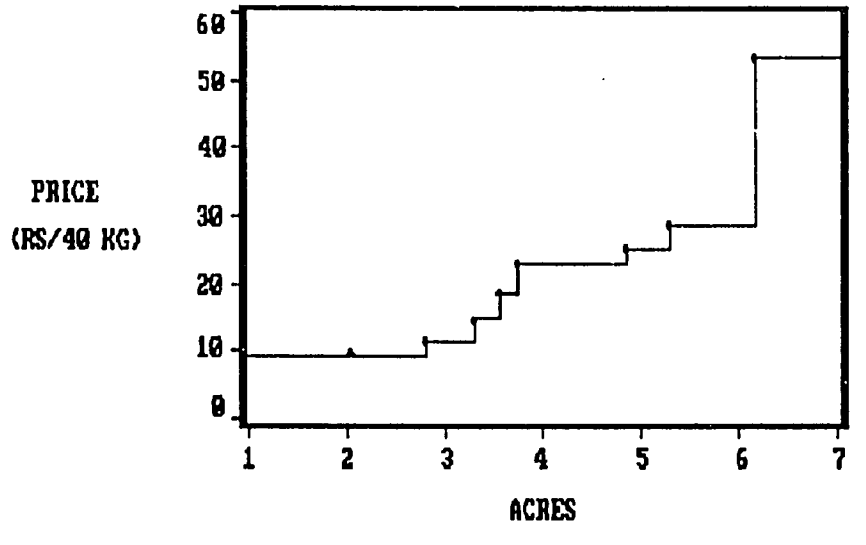
Crops	Historical Cropping Pattern*	Survey Results*	Model Results
Rice	2.80	2.40	0.11
Cotton	30.30	42.30	31.30
Kharif fodder	9.80	10.20	10.10
Kharif vegetables	0.50	0.00	0.25
Sugarcane	12.00	9.10	10.10
Orchards	0.60	2.50	2.50
Wheat	46.10	49.80	57.38
Oilseeds	4.80	0.00	0.00
Rabi fodder	8.20	8.20	10.08
Rabi vegetables	0.30	0.00	0.25
Others	7.00	0.00	0.00
Total:	135.00	136.10	134.66

* Feasibility Report-Command Water Management Project, 1983

The cropping intensity calculated from the survey results was almost the same as predicted by the model. However, the survey results indicated greater acreage under cotton and less acreage under wheat than is predicted by the model. The survey results reflect the price structure faced by the farmers in 1984 when the wheat-cotton output price ratio was 0.34. This ratio had improved to 0.41 in 1987, suggesting increased profitability of wheat crop. Overall, the results are fairly close to the observed situation.

The model identified unstressed production activities of rice, sugarcane, seasonal fodders, orchards and vegetables in the optimal solution. However, in the case of cotton and wheat some modestly stressed activities also became profitable at the margin. The outputs produced under the optimal solution are shown in Table A-5 of Appendix A. The step-wise supply curve for sugarcane (Fig 2.5) was generated through parametric programming. This curve explains farmers' behavior only within a certain range since it limits the solution to various discrete steps. The acreage predicted by the model at each solution change is shown in Table A-6 of Appendix A. In general, the acreage response to price increases turned out to be fairly modest. As a matter of fact, cross-price effects were more pronounced than the own price effects.

FIGURE 2.5 STEP-WISE SUPPLY CURVE OF SUGARCANE ON A REPRESENTATIVE 20-ACRES FARM IN PUNJAB



2.5.4 Sensitivity Analysis

A sensitivity analysis was performed on parameters which were believed to have a direct or indirect effect on sugarcane production at the farm level. These parameters were output and input prices, availability of irrigation water, and sugarcane production technology. Farmers' response to output prices was analyzed assuming a 10% increase in the prices of wheat, sugarcane, and cotton. The impact of fertilizer prices on cropping pattern and farm income was also analyzed. Shadow prices of irrigation water obtained under the base-line solution imply that water is an extremely scarce resource. Sensitivity of the model to variations in water supply was therefore tested by increasing and decreasing the water supply by 10 percent.

To capture the impact of technological innovations on farm income, experimental production functions were incorporated in the model. The data with respect to experimental production functions were taken from PARC (1982). The experimental functions indicate sugarcane yield response to three irrigation levels (13%, 10%, 6% moisture content) against two fertility treatments (NPK of 132-33-55 and 198-66-55 Kg/ha). Other than irrigation and fertilizer, all other factors were held constant. Addition of these production functions in the model provided more flexibility to farmers in decisionmaking since a wide range of input substitution possibilities became available to them. To discount for the differences in management and other related factors, farm level yield was assumed to be 70% of the experimental yield.

Results of the sensitivity analysis are shown in Table 2.5. A 10% increase in cotton price eliminates sugarcane from the optimal cropping pattern, indicating that sugarcane production is highly sensitive to cotton prices. A 10% increase in sugarcane prices, however, has a negligible effect on its own production. Under this situation, net farm income increases by about 4 percent over that of the base line case. When wheat and fertilizer prices are increased by 10% , the area under sugarcane declines by 10.4% and 18.8%, respectively, as compared to the base line case.

Water availability turned out to be a critical constraint in the production process. A 10% increase in water availability would lead to a 16% increase in area under sugarcane and about a 9% increase in net farm income. On the other hand, if water supply is reduced by 10%, area under under sugarcane and net farm income would decline by 17% and 9%, respectively.

When farmers were assumed to have knowledge of new production methods, benefits turned out to be considerable. In this case, the area under sugarcane increased by almost 100% while net farm income increased by about 16.5%. The above analysis suggests that significant increases in sugarcane production can be realized mainly through dissemination of new technical information to

farmers. Availability of increased water supplies would also result in expanding the area under sugarcane. An increase in the sugarcane price, on the other hand would have only a modest impact on sugarcane acreage and production.

TABLE 2.6 IMPACT OF VARIOUS PARAMETERS ON FARM INCOME AND ALLOCATION OF AREA UNDER MAJOR CROPS ON A 20-ACRE FARM IN PUNJAB PROVINCE

Parameter	Farm Income (Rupees)	Acreage under			
		Cotton	Rice	Wheat	Sugarcane
A.OUTPUT-INPUT PRICES					
10% increase in:					
cotton price	17379.00	8.08	0.00	11.35	0.00
sugarcane price	17009.00	5.49	1.56	12.06	2.04
wheat price	17879.00	4.27	1.49	12.78	1.81
cotton, sugarcane and wheat prices	20962.00	5.51	1.58	12.19	2.04
fertilizer price	15839.00	4.23	0.00	12.65	1.64
B.WATER AVAILABILITY					
10% increase	17707.00	6.90	0.00	12.82	2.35
10% reduction	14901.00	5.52	0.36	10.23	1.67
C.TECHNOLOGY	18987.00	4.04	0.02	8.81	4.08
Base-line solution	16305.00	6.26	0.02	11.48	2.02

2.5.5 Farm Level Production Efficiency

We know the technological matrix (a) of our representative farm and its endowment vector (b) from the survey data. Corresponding to these actually observed processes and net revenue vector (c), the farm chooses to have output vector (x). Let the existing total net revenues be denoted as z, which is simply cx. The objective is to determine whether total net revenues of the farm can be increased by reallocating the resources among the crops being produced at the farm using existing technology (a). The LP formulation would be:

$$\begin{aligned} \text{Max} \quad & z_1 = cx_1 \\ \text{subject to} \quad & ax_1 \leq b \\ & x_1 \geq 0 \end{aligned} \qquad [2]$$

z_1 is the maximum value attained by the objective function, and x_1 is the corresponding optimal output vector. Since the actual output vector x is also a feasible solution to [2] because $ax = b$ it must be true that $z_1 > z$. The allocative efficiency (e_a) is defined as z/z_1, where $0 < e_a < 1$. When the actual output vector is the same as optimal output vector, the efficiency will be 100 percent and $e_a = 1$.

In addition to the existing technology matrix (a), the farm can use new technology (a^*) being followed at the experiment station. This technology alongwith its associated net revenue vector c^* is likely to be available to farmers through the local agricultural extension office. The farm has the option to retain its existing technology, or adopt new technology, or even select an intermediate technology between the two. In other words, the farm has complete information with respect to the choice of technology. We have restricted the technology choice in our model to sugarcane production only, although it can be extended to all crops being grown at the farm. The LP formulation would be

$$\begin{aligned} \text{Max} \quad & z_2 = cx_1 + c^*x_2 \\ \text{subject to} \quad & ax_1 + a^*x_2 \leq b \\ & x_1, x_2 \geq 0 \end{aligned} \qquad [3]$$

The ratio z_1 / z_2 can be used as a measure of technical or information efficiency (e_t). Z_1 is the maximum net revenue obtained with the existing technology, while z_2 is the maximum income possible when the additional information about new production technology is available. If the ratio is less than unity, the farm will be be informationally inefficient. The overall economic efficiency (e_e) is the product of allocative efficiency and technical efficiency. Economic inefficiency at the farm can be defined as $(1 - e_e)$.

Allocative efficiency (e_a) of the farm is estimated to be about 94% . In other words, the farmer's net income can be increased from the existing level of Rs 15,262 to a maximum of Rs 16,305 through reallocation of available resources. Results indicated that technical efficiency (e_t) of the farm was about 86%. Alter-

natively stated, an increase of Rs 2,682 in net income of the farm would be possible if additional information about sugarcane production were available to the farmer. Total economic efficiency of the farm was around 80%.

Technical inefficiency accounts for about 72% of total economic inefficiency. The remaining inefficiency on the farm can be attributed to the misallocation of available resources. Higher efficiency in agricultural production can be realized both by reallocating existing resources and providing additional agricultural information to farmers. However, the magnitude of benefits would be higher in the latter case.

2.6 Market Structure of the Sugarcane Sector

Until 1987, the market structure of the sugarcane sector within mill zones was monopsonistic. Marketing of cane to mills was regulated by the Sugarcane Factories Control Act under which each mill was assigned a zone or area from which it was required to procure a specified percentage of its cane requirements. This percentage varied by province. It was 80% in the Punjab, 65 % in the NWFP and 100% in the Sind. The growers in mill zones were in turn obligated to sell a similar percentage of their cane production to the mill.

The minimum price at which cane could be procured by mills was set by the government each year. The use of cane for gur was prohibited in mill zones except for small amounts to meet immediate household needs. The Sugar Factories Control Act specifically prohibited the involvement of middlemen in the marketing of cane to the mills.

Mills were required to maintain a growers register and before the beginning of each crushing season estimate the quantity of cane produced by each grower in their respective zones. On the basis of the production assessments made, indents were issued by mills to growers. These indents authorized growers to supply a specified quantity of cane to the mill at a particular place on a given date. Indents had to be issued in such a manner that purchases from growers were spread equitably over the length of the crushing period. The Provincial Cane Commissioner was responsible for implementation of the Act. Supervisory Committees were to be constituted in each mill zone to ensure that no irregularities or malpractices took place.

A number of mills behaved as economic theory would predict when processors have a captive source of raw material supply. They left prices at the minimum level in their zones and bought marginal amounts at much higher prices outside the zone. They also gave some lifting preference to outside suppliers. Some mills waited until mid-season or later to offer higher prices within

their zones to attract cane from gur production. Many farmers viewed these practices as discriminatory and exerted pressure to sell where they could obtain higher prices.

In May 1987 the Government of Pakistan announced a new sugar policy for the country. The major feature of this policy was the decision to officially abolish the system of zoning from the 1987-88 crop year (for all practical purposes , zoning had not been effectively enforced in Sind for the past two years). Under the new system, farmers are free to supply cane to any mill that offers the highest price. They are also free to convert any quantity of cane into gur. At the same time the minimum support price of cane is to be maintained.

After dezoning, mills are also free to purchase cane from wherever they wish. This greatly alters the market structure and behavior of the industry. It is now an oligopsonistic market where mills can enter the primary supply areas of other mills at will. The economics of transportation and other marketing costs will influence buying decisions and the degree of "cut throat competition" that occurs among buyers. The amount of cane grown in areas adjacent to mills will also dictate the extent to which economic mill zone boundries will be invaded. Supply and demand will dictate the upper limits on price. Cane prices will be above minimum support prices in short crop years and the mills may have to refuse to buy from marginal producers in large crop years (See Appendix B for an industry perspective on the potential impacts of dezoning).

Because of the characteristics of sugarcane, however, economic constraints dictate that the major proportion of sugarcane will still be acquired at minimum prices from producers near the mill. Supplementary supplies will however be procured from more distant areas at higher prices, depending upon supply and demand conditions, to bid the cane away from other users. If higher prices are not paid, transportation costs may be absorbed by the buyer. Eventually mills are likely to come to some tacit agreement on zone areas and develop a "live and let live" attitude. To some extent, mills can be expected to avoid encroaching upon each other's territory to avoid retaliatory action.

Assuming there is sufficient competition among mills for cane supplies, the bargaining position of growers vis a vis mills is likely to improve after dezoning. This is particularly so for large farmers whose ability to convert cane into gur is limited. Small growers are also likely to be in a stronger bargaining position especially in years of a short crop. However, the situation could reverse in years of a bumper crop as the mills would not be under any statutary compulsion to procure all cane offered to them. Instead, mills would continue to have strong incentives, based on managerial considerations, to obtain their cane from a few large growers rather than many small ones. Much would depend,

it would seem, on the level of cane production and availability relative to the mills' requirements.

Most industry representatives interviewed were of the view that dezoning would lead to the emergence of middlemen or brokers. These middlemen, who might also be large growers, would enter into contracts with mills and supply them with cane collected from a multitude of small growers. There is some concern that higher cane prices in years of scarcity would not necessarily be passed on to small growers by these middlemen. On the other hand, to the extent that these middlemen provide various marketing services to small producers and serve as a countervailing power in negotiations with mills, they would be performing an economically useful function. It cannot be determined at this time whether or not the role of middlemen would necessarilly be exploitative.

2.7 Marketing Alternatives and the Supply of Cane to Mills

2.7.1 Historical Trends

A feature of the Pakistan sugar industry is the relatively small proportion of total cane production that is processed by the mill sector. Though this proportion has increased over time, it still accounts for less than half of the total cane produced-- approximately 43% in 1986. An estimated 15% of the cane crop is used for seed, animal feed and direct human consumption, or disappears as post harvest losses. The remaining 40-45% is used to produce local sweeteners such as gur, shakkar and desi sugar. Statistics on the relative share of these sweeteners are not available and the three are normally aggregated in terms of a 'gur equivalent.' Table 2.7 summarizes the trends in the proportion of total cane production crushed by the mill sector over the period 1970-86.

While only 27% of the cane crop was processed by sugar mills in 1970, in 1986 this had risen to 43%. There are significant differences between provinces in the proportion of cane production crushed by the mill sector. In the province of Sind, which does not have any tradition of either gur consumption or production, as much as 96% of the cane crop was processed by mills in 1986. In the NWFP, by contrast, only 10% of the cane produced was crushed by mills in the same year. In the Punjab, which accounts for about 65% of Pakistan's cane output, mills processed around 27% of the cane produced in the province. This percentage is down from the previous year when 37% of the cane was processed by mills and is largely due to the fact that 1986 was a short crop year.

TABLE 2.7 PROPORTION OF CANE PRODUCTION CRUSHED BY THE MILL SECTOR 1970-86

Year	Sugarcane Production (Mill MT)				Cane Crushed by Mills (Mill MT)				Percentage Crushed by Mills			
	Punjab	Sind	NWFP	Total	Punjab	Sind	NWFP	Total	Punjab	Sind	NWFP	Total
1970	19.71	3.40	3.26	26.37	3.92	1.97	1.36	7.25	20	58	42	27
1971	16.83	3.24	3.09	23.17	2.75	2.51	1.27	6.53	16	77	41	28
1972	13.77	2.78	3.40	19.96	1.60	1.14	1.11	3.85	12	41	33	19
1973	13.73	2.92	3.30	19.95	2.03	1.68	0.93	4.64	15	58	28	23
1974	16.62	3.80	3.50	23.91	3.31	2.18	0.89	6.38	20	57	25	27
1975	14.81	2.77	3.66	21.24	2.54	1.37	1.27	5.18	17	49	35	24
1976	18.27	3.59	3.69	25.55	3.89	2.14	1.08	7.11	21	60	29	28
1977	21.79	4.04	3.70	29.52	4.37	3.21	0.71	8.29	20	79	19	28
1978	22.10	4.26	3.72	30.08	3.99	3.55	1.45	8.99	18	83	39	30
1979	19.35	4.37	3.61	27.33	2.27	3.02	0.88	6.17	12	69	24	23
1980	19.41	4.66	3.42	27.50	2.00	3.56	0.23	5.79	10	76	7	21
1981	23.73	5.01	3.60	32.36	4.78	3.54	0.83	9.15	20	71	23	28
1982	25.02	7.46	4.06	36.58	6.66	6.45	1.38	14.49	27	86	34	40
1983	20.88	7.55	4.02	32.53	5.18	6.28	1.06	12.52	25	83	26	38
1984	22.84	7.36	4.07	34.29	6.89	5.63	0.96	13.48	30	76	24	39
1985	20.96	7.43	3.72	32.14	7.74	6.08	0.88	14.70	37	82	24	46
1986	16.76	7.53	3.55	27.86	4.45	7.27	0.35	12.06	27	96	10	43

Sources : Ministry of Food, Agriculture & Cooperatives,
Agricultural Statistics of Pakistan 1984-1986;
Pakistan Sugar Mills Association.

Although the quantity of cane crushed by mills has (with the exception of the NWFP, and the Punjab in 1986) increased over time in both absolute and relative terms, another feature of the industry has been instability in the supply of cane to the mill sector. As in the case of cane acreage, cane supplies to mills seem to follow a cyclical pattern with supplies falling sharply every 3-4 years and resulting in low mill capacity utilization.

2.7.2 Determinants of the Supply of Cane to Sugar Mills

In this section, the major economic and institutional factors which affect the distribution of cane production between mills and alternative uses are described.

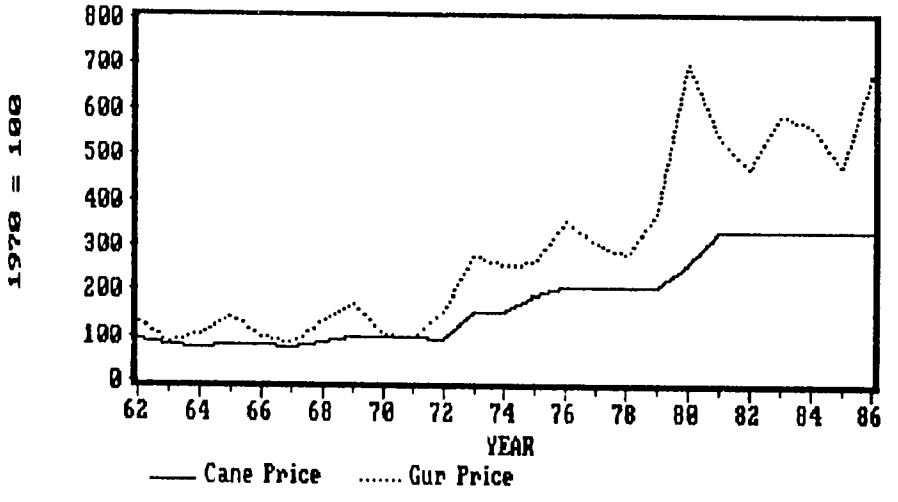
(a) Relative Cane and Gur Prices

From the farmer's perspective, the main alternative to supplying cane to the mills is to make gur out of it. Therefore, one would expect the price of cane relative to that of gur to be an important determinant of the proportion of the cane

crop that is sold to the mill sector. When cane prices are high relative to gur prices, cane growers should, all other things being equal, sell a larger proportion of their crop to sugar mills. Conversely, when gur prices are high relative to the prices offered by the mills for cane, growers should convert a larger percentage of their cane crop to gur.

Movements in cane and gur prices over the period 1962-86 are shown in Figure 2.6. Gur prices seem to follow a four-year cycle which together with constant cane prices over prolonged periods, largely explains the cycles in cane supplies to mills mentioned earlier.

FIGURE 2.6 INDEX OF CANE AND GUR PRICES, 1962-86



Gur prices have exhibited greater variability over time than cane prices because they have been free to respond to changes in supply and demand conditions. In contrast, throughout much of this period, sugar mills have been subject to government price controls. Because the price of their output was fixed, sugar mills have been unable to compete with gur by offering higher prices for cane in years of scarcity. The reverse was true in good crop years since mills were bound to pay the statutory minimum support price for cane irrespective of availability. Price controls on sugar mills thus appear to have amplified the fluctuations in cane production caused by a combination of exogenous factors such as weather and water availability, and a lagged response to prices. While the coefficient of variation of cane production is only 18.06, for sugar production it is 39.15.

A regression analysis relating the relative price of cane to gur with the proportion of cane production crushed by mills did not yield satisfactory results. The relative price variable failed to explain any of the variation in the proportion of cane production processed by the mill sector. However, a very low value for the Durbin Watson statistic suggested the presence of autocorrelation and the function was re-estimated using the Cochrane Orcutt procedure. The results are reproduced below :

$$PCM = \underset{(3.78)}{0.436+1.441(PR)}$$

R-squared = .88 D.W. = 2.22 t = values in parentheses

Where :

PCM = percentage of cane production crushed by mills
PR = price of cane relative to the price of gur

The equation explains 88% of the variation in the proportion of cane production crushed by the mill sector. The regression coefficient for the price variable has the right sign and is statistically significant.

To capture the effects of other variables such as the number of mills, development of marketing infrastructure and relationships, increased cane production etc, a trend variable was added and the function re-estimated.

$$PCM = \underset{(3.65)\quad(8.21)}{-0.070+1.614(PR)+0.015(T)}$$

R-squared = .90 D.W. = 1.80 t = values in parentheses

The results improve only marginally with the inclusion of the trend variable suggesting that the relative prices of cane and gur are the principal allocative mechanism for the distribution of cane output between the mill sector and gur production.

Although the effect of relative cane and gur prices appears to be important at the national level, there are probably important regional differences. In particular, their effect is likely to be insignificant in Sind where gur making is not an economically viable proposition for the large Sind cane growers, nor is there any tradition of gur consumption among the population.

Relative cane and gur prices appear to be much more important in influencing the decision of farmers in the NWFP and Punjab to market cane to mills. Even here, the response of large and small growers is likely to be different. Gur production is a time-consuming and labor intensive process. In contrast to small growers who often employ family labor in gur production, bigger farmers are unable to obtain enough labor to process the large volumes of cane produced by them into gur. Their ability to produce gur from more than a few acres is thus fairly limited. In this sense large cane producers tend to have less flexibility with respect to marketing alternatives than small growers. It would appear, therefore, that the 'swing suppliers' are likely to be small producers. This was confirmed in interviews with mill managers.

(b) Distance from Mills

Distance of a farm from a sugar mill (or procurement center) appears to be another factor which is likely to affect the proportion of cane marketed to mills. This is because higher transportation costs reduce the returns that farmers get from selling cane to mills, relative to domestic gur production.

A study done by the University of Agriculture, Faisalabad found that the proportion of cane output supplied by farmers to mills in Punjab decreased as distance from the mills increased. The same study also reported that farmers on average sold about 75% of their cane crop to mills. This figure is much higher than the provincial average estimated from total cane production and mill crushing statistics. The discrepancy is probably due to the reason that the respondents interviewed were situated in mill zones and, as they were bound by law to provide at least 80% of their cane crop to mills, exaggerated the proportion of cane sold by them to the mills. At the same time, it perhaps also suggests that a considerable area under cane may be located too far from sugar mills to be feasible either for farmers to market or mills to purchase.

(c) Procurement Practices of Mills

Although the cane procurement practices of mills were regulated by the Sugar Factories Control Act, in practice the system worked less than perfectly. A number of studies have documented the problems faced by growers in their dealings with sugar mills. Some of these are discussed below.

(i) Inequitable distribution of indents: A frequent com-frequent complaint of small growers was that the mills gave preferential treatment to large influential growers in the issuance of indents. It was claimed that small growers received fewer and less frequent indents,

usually for later in the crushing season. Small growers thus incurred additional opportunity costs as their crop occupied the field for longer periods of time and subsequent farming operations were delayed. Another complaint was that mills, assured of cane supplies from their own zone, concentrated first on procuring the maximum quantity of cane from outside their zones during the start of the crushing season.

(ii) Long waiting periods at delivery points: A study done by the Agriculturul Prices Commission found that, for each load of sugarcane, growers had to wait, on average, about 10 hours at delivery points. Often the waiting period at the mill gate was as much as 12-18 hours. Lines of trucks, tractor trollies, and bullock carts backed up as far as the eye can see, are a common sight at sugar mills during the crushing season.

(iii) Malpractices: Malpractices by mill employees in the weighing of cane and acceptance of deliveries were also reported.

(iv) Late payment by mills: The Sugar Factories Control Act requires the millowner or purchasing agent to make full payment for cane within one week from the date of delivery. The same study by the Agricultural Prices Commision found that it took, on average, about 17-25 days for a cane grower to receive payment for his cane.

To the extent that these procurement practices undermine the confidence of growers in mills they make alternative uses of cane (such as gur production) more attractive, and therefore affect the quantity of cane marketed to the mill sector.

(d) Transportation Facilities

Access to transportation facilities has an important influence on the range of marketing alternatives open to farmers. Potentially at least, a lack of access to transportation facilities can be a serious constraint to the marketing of cane to mills. However, this aspect of cane marketing has not received much attention though interviews with farmers suggest that it may be an important factor.

2.8 Summary and Conclusions

Sugarcane production in Pakistan has increased by over 4% per year over the past forty years. High support prices for cane and an expansion in mill capacity have been the major factors responsible for this growth. The increase in cane production has occurred primarily through an expansion in area with little im-

provement in yields. A feature of cane production has been its variability which has closely mirrored variations in cane acreage. In recent years, sugarcane production has stagnated because of reduced water availability due to drought, and a fairly prolonged period of static cane prices.

The sugarcane sector is characterised by low and stagnant yields and low sugar content compared to other major sugarcane producing regions of the world. To some extent, low yields are due to to an unfavorable climate but they also reflect poor cultivation practices, inadequate fertilizer and pesticide use, and a lack of high yielding varieties. Low yields are a major reason for the high cost of production of sugarcane. The present system of cane payment by weight further discourages farmers from improving the sucrose content of cane.

Another characteristic of the sugarcane sector is instability in the supply of cane to sugar mills. Although other factors are also important, the price of gur relative to that of cane is the major factor determining the quantity of cane supplied by farmers to the mill sector. The instability in cane supplies is related to the cyclical behavior of gur prices, and to variations in cane acreage and production due to the practice of ratooning. Price controls on sugar mills have contributed to this instability in the past.

Future trends in sugarcane production will depend largely upon how fast cane prices grow relative to those of cotton and fertiliser. They will also depend upon the extent to which technology improvements occur in the sugarcane sector. If cane production is to to grow at the same rate as it has in the past, cane prices will have to rise significantly. This poses a problem for policymakers since cane support prices are already fairly high relative to other countries and because further increases may encourage production by displacing other crops which are also important for the country.

In these circumstances, future growth in sugarcane production will have to come increasingly from higher yields rather than expanded acreage. For this to happen, both the government and industry will have to devote more resources and attention to research in improving cane varieties than they have done in the past. At the same time, the coverage and effectiveness of extension services will need to be improved and a cane payment system instituted that puts a premium on quality rather than weight.

Whole farm analysis also suggests substantial benefits to improvements in technology and dissemination of new technical information to farmers. In contrast, it indicates only a modest production response to increases in the support price of cane.

3. THE PROCESSING SECTOR

3.1 Background

At the time of partition there were only two sugar mills in the area which is now Pakistan--one each in the NWFP and Punjab. Since then, the sugar industry has emerged as a major processing industry second only to textiles in importance.

The foundations for the development of a domestic sugar industry were laid in the 1950s with the establishment of four sugar mills, three of which were set up by public sector agencies. The direct involvement of the government in the establishment of sugar mills was apparently not based on any ideological considerations. It stemmed instead from a growing concern about rising refined sugar imports and a deteriorating balance of payments situation combined with the reluctance or inability of the private sector to invest in the industry.

More rapid growth in sugar production capacity occurred during the 1960s when high domestic sugar prices, liberal sanctioning and credit policies, and a generally "pro business" policy environment helped create conditions conducive to private investment in the industry. As Table 3.1 shows, installed crushing capacity increased by nearly 25,000 metric tons-per-day over this period.

TABLE 3.1 THE DEVELOPMENT OF THE PAKISTAN SUGAR INDUSTRY, 1947-86

PERIOD	NUMBER OF MILLS ESTABLISHED	PROCESSING CAPACITY INSTALLED (metric tons/day)	
		CANE	BEET
UPTO 1950	2	1,800	
1951-60	4	9,450	1,500
1961-70	13	24,400	5,000
1971-80	12	24,000	2,150
1981-86	10	22,000	
TOTAL	41	81,650	8,650

Source : Ministry of Industries

Of the 13 mills set up during the 1960s, 12 were in the private sector. This period also saw the establishment of the first sugar mill in the province of Sind as well as the addition of beet processing plants to two sugar mills in the NWFP.

Sugar manufacturing capacity continued to grow in the 1970s and 1980s as various tariff and non-tariff restrictions on the import of sugar made domestic sugar production profitable. Twelve new mills were commissioned in the 1970s. However, reflecting new government priorities, half of these were in the public sector.

In the late 1970s government policy shifted again, this time in favor of the private sector. Sanctions increased steadily and 10 new sugar mills were established between 1980-86, bringing the total number operating in the country to 41. Nearly all of the new capacity created was in the Punjab and Sind.

Because of the importance of its product on the urban market, the refined sugar industry in Pakistan has been subject to wide ranging government interventions throughout much of its history. Principal among these have been: (a) price controls on refined sugar; (b) a partial or full government monopoly on the purchase of refined sugar and its distribution through ration or Fair Price Shops; (c) the setting of minimum support prices for sugarcane purchased by the mills; and (d) the requirement of government approval for investment in new capacity in the industry (See Chapter 6).

While these policies achieved to some extent the objective of providing sugar to urban consumers at low prices, they came under increasing strain in the late 1970s as production stagnated, imports grew, and budgetary subsidies were required to keep consumer prices below production costs. In 1981, the government raised the prices of both cane and refined sugar, and allowed mills to sell 10% of their production in the open market.

Higher levels of cane output in response to the increase in cane prices led to the development of a surplus of sugar over domestic demand in the early 1980s. As a result, the government felt confident enough to lift all price and distribution controls on refined sugar in August 1983. Mills have since been free to sell sugar to whomsoever they please and at whatever price the market can bear.

The government continues to intervene in the refined sugar market to ensure the availability of sugar to consumers, promote price stability and protect the domestic sugar industry. The primary instruments used to achieve these objectives are the level of import duties on refined sugar and the direct import of sugar on public account and its sale at fixed prices through the Utility Stores Corporation.

In contrast to many other sugar producing countries, mills in Pakistan derive their cane supply from a large number of small growers scattered over a wide area. Partly to assure them of adequate cane supplies, mills were until recently allocated zones or areas in which they had exclusive procurement rights and growers were required by law to supply them a specified percentage of their cane production.

As new mills were established, competition for cane supplies within the industry intensified and it was increasingly felt that the mill zoning system was preventing the benefits of this competition from being passed on to the farmers in the form of higher cane prices. Therefore, despite opposition from the sugar industry, the government abolished the zoning system in May 1987. With dezoning, the market for raw materials has also been deregulated. Mills can now legally compete with each other for cane supplies and growers are at liberty to sell cane to any mill they choose or to make gur out of it.

In summary, the sugar industry at present appears to be in transition as it moves from a highly regulated environment to one characterized by not only more freedom but greater uncertainty and competition. The future of the industry will depend largely upon how successfully it adjusts to these new realities.

3.2 Industry Characteristics

3.2.1 Installed Capacity

There are 41 sugar mills operating in Pakistan of which 20 are in the Punjab, 16 in the Sind and 5 in the NWFP. Together, they are reported to have a processing capacity of 82,150 metric tons per day of cane and 8,650 metric tons per day of beet. This translates, according to official estimates, to an annual sugar manufacturing capacity of about 1.2 million metric tons (Table 3.2).

There are good reasons to believe, however, that this estimate understates the real production capacity of the industry. First, most of the reported capacities of individual mills were 'fixed' by the Central Board of Revenue for tax purposes and are generally regarded to have been assessed quite conservatively. Second, the requirement of government approval for expansion of existing plants encourages under-reporting of installed capacities, particularly, in cases where mills may have extended their plants without obtaining government permission. Finally, the government does not seem to have any system for updating figures relating to capacities of individual mills in case of expansion of existing facilities. Because of these factors, it is likely that the real production capacity of the sugar industry is higher than official estimates.

TABLE 3.2 INSTALLED SUGAR MANUFACTURING CAPACITY [1]

	NO. OF MILLS	ANNUAL SUGAR MANUFACTURING CAPACITY (Metric Tons)	PERCENT
PUNJAB	20	522,240	45
SIND	16	455,040	39
NWFP	5	194,445	17
PAKISTAN	41	1,171,725	100

[1] Annual capacity is based on the assumption of 160 working days and a sucrose recovery rate of 8% in the NWFP, 8.5% in the Punjab and 9% in the Sind for cane, and 45 working days with a 10% recovery rate for beet.

Source : Ministry of Industries

The government has sanctioned an additional capacity of 0.3 million metric tons, part of which is currently being installed. Within the next few years, therefore, Pakistan will have an annual sugar manufacturing capacity of around 1.5 million metric tons. The actual production capacity, as discussed earlier, is likely to be even higher.

There are nine sugar mills in the public sector, which account for almost one-fourth of the total installed capacity in the industry. However, they are owned and operated separately by a number of public sector agencies. The more prominent of these are the Punjab Industrial Development Board (PIDB), the Sind Sugar Corporation (SSC) and the Sarhad Development Authority (SDA). The SDA, the PIDB and the SSC all operate two mills each in their respective provinces. No industry group, either in the public or private sector, has a large share of production or sales. The biggest, the Fauji Foundation with three mills, accounts for less than 15% of total sugar production.

Existing sugar mills range in capacity from 600 to 4000 metric tons of cane per day, though the typical size is about 2000-2500 metric tons. More recently, there has been a trend towards the construction of larger sugar mills primarily in order to improve efficiencies and reduce unit production costs.

Sugar mills operate seasonally. The average crushing period extends for about 6-7 months (from October to April), depending

upon the availability of cane. In contrast to other countries, beet is grown as a spring crop and is processed during the months of May and June.

There are two major production processes used in sugar plants in Pakistan: the double carbonation double sulphitation (DCDS) process and the defecation remelt (DR) process. Almost all the mills set up in the last ten years are based on the DR process. Four existing mills have also converted their plants to this technology. The DR process is preferred because of its lower operating costs due to savings in the use of process chemicals and coke. It is also reported to produce a somewhat better quality product.

The sugar industry in Pakistan is fairly well organized and all mills are members of the Pakistan Sugar Mills Association which represents the industry in various government and non-government forums. Another important body is the Pakistan Society of Sugar Technologists (PSST) whose membership is drawn from professionals employed in the sugar industry. The PSST is the source for most of the technical data related to sugar production available in the country.

3.2.2 Investment and Employment

Statistics on total investment in the sugar industry are not readily available. However, based on financial reports published by individual mills, the National Development Finance Corporation (NDFC) estimated the total value of gross fixed assets in the industry at Rs 6.5 billion in 1983. Taking into account new units set up during the last three years, a conservative estimate of total fixed investment in the sugar industry to date would be over Rs. 7 billion.

According to the latest Census of Manufacturing Industries, average daily employment per plant in the sugar industry was 926 in 1982. This is one of the largest figures reported for the manufacturing sector although half of it represents seasonally employed labor. On the assumption that this average has not changed significantly, the sugar industry is estimated to provide direct employment to over 40,000 persons.

3.2.3 Structure of the Refined Sugar Market

Before decontrol of the refined sugar market in 1984, the market was monopsonistic throughout the whole country. There was one buyer: the government. On the sellers' side, the structure could be termed oligopolistic but there were no grounds for competition since the government dictated all terms of trade and all sugar produced was purchased at the time of production.

The government set prices of sugar for old and new mills and dictated when and where sugar would be sold. Each week mills would verify production and were paid 70% of the value of the sugar produced including the excise tax. This provided more than sufficient working capital for mills to make prompt payment to producers (within 15 days by law). However, there was considerable red tape involved, and at times delays, in collecting the advance payment from the government.

At the same time, sugar was rationed to consumers and was sold through specific government operated outlets at fixed prices. These retail outlets were located primarily in urban areas. Rural consumers had limited access to sugar. Cane producers were given the right to purchase white sugar from mills at a government fixed price. The quantity that producers were permitted to buy was determined by the amount of cane or beets supplied to mills. This right persisted until the time of dezoning.

After decontrol, mills have been free to sell sugar to users or wholesalers. Buyers are required to obtain a permit to buy sugar but this does not appear to be a difficult process. Public sector mills are required to publicize tender offers for sugar sales and then receive buyers offers. Buyers must provide 3% up front money to insure that they will perform on their promise to buy. Since there is an interest cost on this money, prices for sugar from these public sector mills are somewhat discounted relative to private sector mills in order to make sales.

For the first time, the industry is now required to evaluate marketing plans and sell or store sugar as necessary to meet cashflow requirements and obtain the highest seasonal prices. Mills must now finance their own operating capital requirements since the government no longer owns the sugar. Processors are highly aware of the competitive actions of other mills. Buyers have indicated a willingness to pay higher prices for better quality sugar. This has stimulated mills to improve the quality of sugar sold in a relatively short time period.

Since decontrol, the structure of the refined sugar market has changed dramatically. On the buying side it is mostly oligoponistic, where a relatively few large wholesalers and users buy from relatively few sugar mills (oligopolists) who compete with each other for sales. The relative bargaining power between buyers and sellers depends upon the size of the buyer and upon the cash flow position of individual mills. If they require funds for operating capital there is pressure to make distressed sales. Storage availability is also a determinant of bargaining power. If sugar cannot be stored it must be sold when produced rather than wait for seasons of higher demand. Supply and demand now set the price both at the wholesale and at retail level. The government and private firms import sugar to keep sugar prices "within bounds."

3.2.4 The Cottage Sector

A major feature of the Pakistan sugar industry is the existence, particularly in the Punjab and NWFP, of a large cottage sector producing "desi" (local) sweeteners such as gur and shakkar. Most gur and shakkar production takes place on the farm by small cane growers who utilize their family labor and the animal power already available on the farm. Commercial gur production by non-farmers is only evident in the NWFP where gur prices have been higher.

Despite the rapid growth of the refined sugar industry, about 40% of the total cane produced is still processed in the cottage sector. This sector, given the practical difficulties of regulating thousands of small producers, remains virtually free from government controls. On the demand side, its products both substitute and complement refined sugar production. At the same time, the cottage sector competes with the mills for available cane supplies. This competition, in combination with fluctuations in cane production due to various factors such as weather, water availability, and relative crop prices, has produced considerable instability in the supply of cane to the mills.

The sugar industry in the NWFP, in particular, has been badly affected by competition with the cottage sector for cane supplies. Production has fallen and, with the exception of one or two mills, the industry is in serious financial difficulties requiring special assistance from the government, in the form of tax exemptions and subsidies for higher cane prices to farmers, to continue operating.

3.2.5 By-product Utilization

A widely held view is that the sugar industry is characterized by poor utilization of by-products. To the extent that this is true, it reflects more the absence of a large domestic market for processed by-products, competition both in domestic and international markets from foreign sugar industry by-products, and the existence of strong incentives for mills to consume by-products themselves.

major by-product of the industry is bagasse which, till recently, was used mainly in paper and chipboard manufacture. Shortages of gas and restrictions on its use, however, have induced mills to increasingly utilize bagasse as a source of fuel for their boilers. The industry apparently is still surplus in power, especially during the off-season, and there is currently interest in using this surplus capacity to generate electricity for commercial puposes.

The other main by-product produced by the industry is molasses, three-fourths of which are exported without further processing. The rest are used in animal feed and tobacco blending, and for the production of industrial alcohol. There are nine distilleries in the country, of which six are attached to sugar mills. However, they appear to be operating well below their designed capacity.

During the past few years, there has been some investment in new projects based on sugar by-products, for example the production of liquid sugar from molasses, and furfural from bagasse. Nevertheless, on the whole, by-product usage remains relatively unsophisticated, with the result that the cost of cane is borne almost entirely by sugar.

3.2.6 Research and Development

All sugar processors are involved to some extent in cane development activities. These include the provision of seed, fertilizer, credit, pesticides and technical advice to growers. However, despite the wide array of develpoment activities carried out by the mills, their coverage remains limited and only a small number of farmers are able to benefit from such activities.

A few mills, notably those operated by the Fauji Foundation, have fairly large experimental farms which are used for field trials as well as seed multiplication for distribution to farmers. Most, however, continue to rely upon selected growers to supply them with seed. Mills provide farmers credit, either directly in the form of fertilizer, pesticides and seed, or indirectly by arranging bank loans for which they act as guarantors.

Much of the agronomic research on cane is carried out by government research agencies, principally the Sugarcane Research Institute at Faisalabad and the Sugar Research Station at Mardan. Their effectiveness, however, remains limited due to a lack of funds and specialist staff, and poor links with both the sugar industry and government extension agencies. Another problem is that many of the recommendations made by these institutions are not feasible for farmers to adopt given the existing cane payment system which puts a premium on weight rather than quality.

There is virtually no industry involvment in research and development activities on a collective basis, though a modest beginning has been made with the establishment of the Sugar Industry Research Institute at Hyderabad. But the institute has limited industry support and, like the government research facilities, is plagued by a shortage of funds and staff. There appears to be no research or training facility for sugar mill technologists in the country.

3.3 Operating Performance

3.3.1 Production and Capacity Utilization

Sugar production grew at an average rate of 3.8% per year over the period 1970-86. This growth was associated with increases in both milling capacity as well as sugarcane production. Information on installed capacity, production and capacity utilization in the sugar industry over this period is presented in Table 3.3. The same table shows that there were marked differences in production performance between provinces.

TABLE 3.3 PAKISTAN SUGAR INDUSTRY CAPACITY AND UTILIZATION, 1970-86

YEAR	ANNUAL PRODUCTION CAPACITY ('000 MT)				PRODUCTION ('000 MT)				CAPACITY UTILIZATION (%)			
	Punjab	Sind	NWFP	Pakistan	Punjab	Sind	NWFP	Pakistan	Punjab	Sind	NWFP	Pakistan
1970	237	131	146	514	315	171	129	615	133	130	88	120
1971	237	131	146	514	238	221	77	536	101	169	53	104
1972	237	203	146	586	147	104	95	346	62	51	65	59
1973	291	203	146	640	180	160	99	439	62	79	68	69
1974	318	203	146	668	263	242	93	598	83	119	64	90
1975	318	225	146	689	225	143	130	498	71	64	89	72
1976	318	253	146	718	320	206	105	631	101	81	72	88
1977	318	253	194	766	348	294	94	736	109	116	48	96
1978	318	282	194	795	350	356	150	856	110	126	77	108
1979	359	311	194	865	201	301	107	609	56	97	55	70
1980	359	311	194	865	177	348	49	574	49	112	25	66
1981	441	311	194	946	408	337	108	853	93	108	56	90
1982	441	340	194	975	563	586	150	1299	128	172	77	133
1983	468	340	194	1002	433	585	110	1128	93	172	57	113
1984	522	397	194	1114	558	506	85	1149	107	127	44	103
1985	522	455	194	1172	649	577	87	1313	124	127	45	112
1986	522	455	194	1172	371	702	43	1116	71	154	22	95
MEAN ANNUAL PERCENT INCREASE												
1970-86	5.1	8.1	1.8	5.3	1.0	9.2	-6.6	3.8	-3.8	1.1	-8.3	-1.4

Source : Ministry of Food, Agriculture and Cooperatives,
Agricultural Statistics of Pakistan, 1972, 1984,1985;
and the Ministry of Industries

While sugar production grew at a rate of 9.2% and 1% per annum in the Sind and Punjab respectively, it actually declined by 6.6% per year in the NWFP. As a result, Sind increased its share of total sugar production from 28% in 1970 to 63% in 1986, while the NWFP's share fell from 21% to 4% over the same period. The growth of the sugar industry in Sind has benefitted from, among other factors, favorable climatic conditions, the absence of a cottage sector, and the existence of relatively large landholdings.

Sugar production from beet declined by about 40% during this period, from 23,085 metric tons in 1970 to 13,969 metric tons in 1986. Despite its importance to the NWFP sugar industry where it accounted for almost one third of total sugar production, sugar-beet remained insignificant at the national level, representing less than 2% of the total sugar produced in 1986.

The various growth rates indicated above give a somewhat distorted picture of production trends in the sugar industry due to the inclusion of 1986 as the end-year for the period under review. This is because the latter was a low production year, particularly in the Punjab and the NWFP. Nevertheless, they are illustrative of broad industry trends during this period and depict important regional shifts in production which have taken place over the past 15 years.

Average capacity utilization in the industry fell from 120% in 1970 to 95% in 1986; the latter, however, was an unusually bad year. Generally, utilization rates have varied from year to year depending upon the availability of cane. The sugar industry appears to have been operating close to its reported capacity in recent years. However, again there are significant regional differences. The NWFP sugar industry, for example, operated at only 22% of its installed capacity in 1986 because of a shortage of cane. In contrast, the Sind sugar industry operated at 154% of its capacity in the same year.

Regional differences in capacity utilization rates are also reflected in the average length of the crushing period. Table 3.4 shows that mills in the NWFP operated on average for only 91 days in 1986 as compared to 187 days for Sind, and 119 days for the Punjab.

Even allowing for the length of the crushing season, the very high capacity utilization rates reported for mills in Sind (and in certain years for those in the Punjab) seem to confirm earlier suspicions that the installed capacity of the industry is considerably underestimated.

TABLE 3.4 LENGTH OF CRUSHING SEASON, 1980-86

YEAR	PUNJAB	SIND	NWFP	PAKISTAN
	(days)			
1980	124	161	102	132
1981	176	161	137	165
1982	207	251	149	214
1983	153	220	131	172
1984	165	176	117	163
1985	175	180	114	169
1986	119	187	91	141

Source : Pakistan Society of Sugar Technologists

3.3.2 Recovery Rates

Sugar recovery rates, as normally reported, refer to the amount of sugar produced from a given quantity of cane, expressed in percentage terms. These rates are generally lower in Pakistan than in other countries and, as Table 3.5 shows, there has been virtually no improvement in sucrose recoveries over the period 1970-86.

Sind has the highest recovery percentage in the country, which basically reflects the favorable agro-ecological conditions in the province for cane cultivation, such as a longer growing season, and a humid climate.

Low sugar recoveries in Pakistan are largely attributable to the poor quality of the cane produced rather than the inefficiency of the processing sector. A better indicator of the efficiency of sugar mills is the overall recovery rate which measures the amount of sugar produced as a percent of sugar in the cane. Not all the sugar present in the cane can be extracted, however, because of foreign matter and an incomplete molecular chain. Recovery rates, therefore, are also often reported after adjusting for the sugar purity of the juice, which is a measure of the recoverable proportion of sugar in the cane. Overall recovery rates for the Pakistan sugar industry over the period 1980-86 are presented in Table 3.6.

These figures indicate that mills in Pakistan recover, on average, about 78% of the sugar present in the cane. While this recovery rate appears to be low, if consideration of cane quality is taken into account, it is in line with that of other countries.

TABLE 3.5 RECOVERY PERCENTAGE FROM CANE, 1970-86

YEAR	PUNJAB	SIND	NWFP	PAKISTAN
	percent			
AVERAGE 1970-80	8.5	9.2	7.9	8.7
1980	8.9	9.8	8.0	9.4
1981	8.5	9.5	9.1	9.0
1982	8.3	9.1	8.7	8.7
1983	8.3	9.3	8.8	8.8
1984	8.1	9.0	7.2	8.4
1985	8.4	9.5	8.8	8.9
1986	8.3	9.7	8.2	9.1

Source : Ministry of Food, Agriculture and Cooperatives, Agricultural Statistics of Pakistan for the years 1970-85; Pakistan Sugar Mills Association for 1986.

TABLE 3.6 OVERALL RECOVERY RATES IN THE PAKISTAN SUGAR INDUSTRY, 1980-86

YEAR	OVERALL RECOVERY	REDUCED OVERALL RECOVERY [1]
	(percent)	
1980	78.9	85.0
1981	78.1	84.9
1982	76.6	84.6
1983	77.3	84.3
1984	76.1	84.3
1985	76.8	84.3
1986	77.7	84.8

[1] Adjusted for sugar purity

Source: Pakistan Society of Sugar Technologists

At the same time, there is clearly still room for improving recoveries. Some reduction in the sucrose content of cane occurs because of the considerable delays between the time the cane is harvested and when it is actually processed. To some extent these delays are inevitable due to the organization of cane production in small, scattered holdings. However, other factors are also responsible. These include manual harvesting and loading methods, an inefficient cane transportion system, inadequate handling facilities at the mill gate, and poor procurement and production scheduling by mills.

3.4 Cost and Capital Structure of the Sugar Industry

3.4.1 Sugar Production Costs

Sugar production costs were estimated at the national and regional levels from the audited financial accounts of sugar mills listed on the Karachi Stock Exchange. These estimates are presented in Table 3.7.

TABLE 3.7 WHITE SUGAR PRODUCTION COSTS, 1986

	PUNJAB	SIND	NWFP	PAKISTAN
	(Rs/kg)			
Raw material	3.27	3.30	3.28	3.29
Processing cost :				
Process stores/maint.	0.67	0.59	0.46	0.61
Wages & salaries	0.58	0.34	0.63	0.44
Utilities	0.14	0.11	0.66	0.14
Admin & selling	0.37	0.25	0.60	0.31
Depreciation	0.35	0.23	0.83	0.29
Interest/Fin.chrgs	0.40	0.20	0.51	0.28
Value of by-products	(0.34)	(0.20)	(0.25)	(0.25)
Miscellaneous	0.08	0.05	0.02	0.06
Subtotal:	2.26	1.57	3.46	1.88
Production cost excl. excise taxes	5.53	4.87	6.75	5.17
Excise taxes	2.15	1.72	1.27	1.86
Total production cost	7.68	6.59	8.02	7.03

Source: Annual reports of sugar mills listed on the Karachi Stock Exchange, 1986

The average ex-factory production cost of refined sugar in Pakistan was approximately Rs 7.03 per kilogram in 1986. Mills in Sind had the lowest production cost in the country, followed by those in the Punjab and the NWFP. The production cost of refined sugar per kilogram was Rs 6.59 in the Sind, Rs 7.68 in the Punjab, and Rs 8.02 in the NWFP. Excluding excise taxes, the production cost per kilogram was Rs 4.87 in Sind, Rs 5.53 in the Punjab, and Rs 6.52 in the NWFP.

These estimates are likely to be somewhat biased as the sample does not include mills either in the public sector or those recently established. Since mills in these two categories are generally regarded to be relatively high cost producers, their exclusion probably results in under-estimation of average production costs in the industry. On the other hand, this bias is probably offset to some extent by the tendency of private firms to overstate their costs in published financial accounts in order to reduce the amount of taxable income reported, though the extent of this 'padding' is difficult to determine. Despite the obvious limitations of the data, the estimates derived from them still provide useful information on the level and structure of costs in the industry and their variation by region.

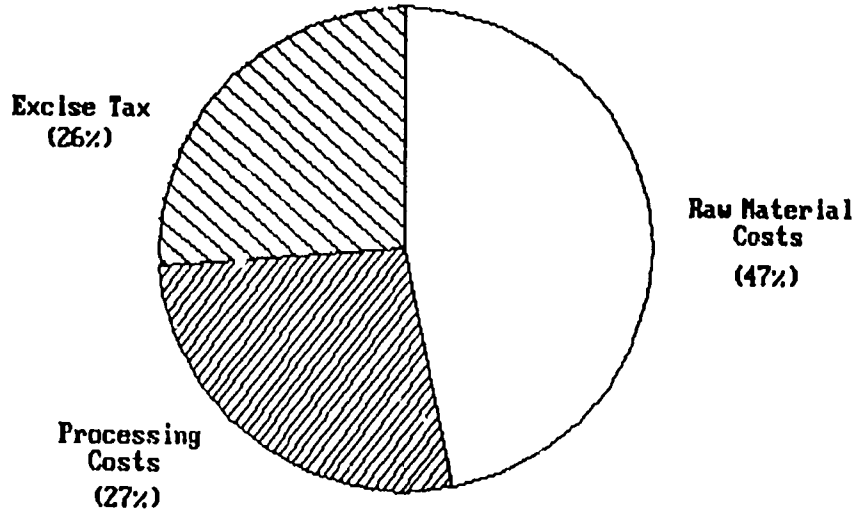
There appear to be two reasons why sugar production costs vary by province. First, mills in Sind have had much higher capacity utilization rates compared with those in the Punjab and NWFP where lower cane production, coupled with competition from gur making, have sharply reduced the availability of cane to the mill sector. This has resulted in lower unit production costs for mills in Sind as their fixed operating expenses, such as depreciation, interest, wages and salaries and other overheads, were spread over a larger output.

Second, mills in Sind were also able to benefit from current government regulations which stipulate that production in excess of the previous two years average be exempt from excise taxes. As a result, the average excise duty paid by them was only Rs. 1.72 per kilogram of sugar produced compared to Rs. 2.15 per kilogram in the Punjab. While the lowest excise duties per unit of production were paid by mills in the NWFP, this was because the government has exempted sugar produced from beet from excise taxes as compensation for the higher fuel costs incurred on its processing.

Interestingly, the higher recovery rates reported for mills in Sind were not reflected in lower raw material costs per unit of sugar produced. These costs were practically the same for all three provinces. Given the recovery rates for the Punjab and Sind in 1986, it would therefore appear that mills in Sind paid about 20% higher prices for cane than those in the Punjab.

Figure 3.1 graphically depicts the composition of refined sugar production costs in Pakistan.

FIGURE 3.1 STRUCTURE OF SUGAR PRODUCTION COSTS, 1986



Raw materials, i.e. cane and beet, accounted for as much as 47% of total refined sugar production costs. Excise taxes accounted for another 26%, while actual processing costs represented only 27% of total production costs. Since, strictly speaking, only the latter can be viewed as being subject to the direct influence of mills, it would appear that almost three-fourths of total refined sugar production costs are due to factors beyond the control of the industry.

Although more recent data are not available, the production costs of new mills were estimated to be about 15% higher than those of older mills in the industry in 1983. As Table 3.8 shows, this was mainly due to higher depreciation charges and interest expenses incurred by new units because of their larger fixed investment costs. Because of the cost differential between old and new mills, the government has provided the latter a 50% excise duty exemption on their production for the first two years of operation.

TABLE 3.8 PRODUCTION COST OF OLD VS NEW SUGAR MILLS, 1983

	OLD MILLS [1]	NEW MILLS
	(Rs/kg)	
Average Investment Cost	Rs.77 million	Rs.243 million
Variable Cost :		
Raw material & others	3.83	3.68
Excise tax	1.89	1.99
Total	5.72	5.67
Fixed Cost :		
Depreciation	0.16	0.62
Interest	0.16	0.88
Others	0.45	0.37
Total	0.77	1.87
Total Processing Cost	6.49	7.54

[1] Old mills are defined as units set up before 1978.

Source : National Development Finance Corporation

The estimated cost of a new sugar mill at present is about Rs 350 million (US $19 million) though its capacity is also typically larger than that of older mills. While the higher fixed operating costs of these mills would to some extent be offset by savings due to greater economies of scale, it is likely that production costs will increase further as more new mills are established.

Available data does not permit any current comparisons to be made between public and private sector mills. However, using data from an earlier study done by the National Development Finance Corporation (NDFC), it was estimated that the production cost of public sector units was about 15% higher than that of private sector mills in 1983. This was mainly due to the existence of a few high cost producers in the public sector, one of which has since been denationalized. The production costs of many public sector mills, for example, Kamalia Sugar Mills as well as those operated by the Sind Sugar Corporation, were comparable to those of any unit in the private sector of a similar age and technology.

Production costs also seem to differ by technology. A study done by the NDFC found that the total variable costs of mills using the defecation remelt (DR) process were about 8% lower than those

based on the double carbonation double sulphitation (DCDS) process. The DR process was more economical in the use of power, fuel and labor. In addition, expenditure on maintenance was also lower for mills based on this process. The difference in the overall production cost between the two processes would, however, be somewhat less if fixed costs, such as depreciation and interest expenses, are taken into account because of the relatively higher investment costs of the DR process.

3.4.2 Capital Structure

Information on the capital structure of the sugar industry is summarized in Table 3.9. With an overall debt equity ratio of 53:47, the industry as a whole does not appear to be highly leveraged. This average, however, masks considerable diversity in the capital structure of firms in the industry. Many recently established firms have debt-equity ratios of up to 80:20 while some of the older ones carry no debt whatsoever. The former are highly leveraged because financing institutions normally require that sponsors of new sugar mills contribute only 20-25% of the total project costs.

TABLE 3.9 CAPITAL STRUCTURE OF THE PAKISTAN SUGAR INDUSTRY, 1983

	(million Rupees)
Total Capital Employed:	
Current Assets	3,652
Net Fixed Assets	4,486
Investments [1]	542
Total	8,680
Sources of Financing:	
Current Liabilities	3,669
Equity	2,208
Debt	2,458
Other Liabilities	345
Total	8,680

[1] Includes investments in government securities, associated companies and deposits in banks.

Source : NDFC

Sugar manufacturing is a seasonal industry. Production takes place over a period of 4-6 months during winter and spring. On the other hand, sales are more or less uniform throughout the year with a peak occurring during the summer months as demand for sugar increases because of greater consumption of soft drinks. At the same time, mills are under a legal obligation to pay cane and beet suppliers within a week of purchase.

Because of the need to finance inventories, pay growers, and meet other expenses during the operating season, substantial working capital funds are employed by the industry for short periods. Even though these seasonal working capital requirements are not captured by the end-of-year figures reported in the financial accounts of sugar mills, current assets represented about 42% of the total capital employed by the industry in 1983. Most of this consisted of finished goods inventories.

3.5 Profitability

3.5.1 Mill Profitability

Returns on investment and equity in the sugar industry over the period 1980-86 are shown in Table 3.10. Mill profitability during this period appears to have been associated with the price of sugar relative to the price of cane and the extent to which mills qualified for the excise duty exemption given on production in excess of the previous two years' average.

Until 1983, returns to the industry were essentially determined by government pricing and taxation policies. The industry was subject to varying degrees of price and distribution controls and the ex-factory price of refined sugar was fixed by the government. A three-tiered pricing system was in effect during this period with higher prices fixed for new mills to reflect their greater production costs. At the same time, mills had to purchase cane at or above the government announced minimum support prices.

While the government sought to ensure a reasonable return to the industry, price controls introduced considerable inflexibility into the system. The fixed ex-factory sugar price and minimum procurement price for cane imposed severe restrictions on the ability of sugar mills to compete with the cottage sector for cane supplies, particularly in years of a short crop. This resulted, as in 1980, in sharply reduced availability of cane to the mills and consequently an extremely low rate of capacity utilization for the industry. The low returns on investment and equity in 1980 appear to be partly due to this reason.

TABLE 3.10 RETURN ON INVESTMENT AND EQUITY IN THE SUGAR INDUSTRY [1], 1980-86

	RETURN ON INVESTMENT	RETURN ON EQUITY
	----------percent---------	
1980	7.7	8.1
1981	19.5	32.2
1982	21.1	31.5
1983	15.5	22.8
1984	10.5	11.9
1985	13.4	21.2
1986	19.1	28.2

[1] Based on the financial accounts of mills listed on the Karachi Stock Exchange.

Source : Karachi Stock Exchange for 1980-84, Annual Reports for 1985-86.

In 1981, the government increased the support price of cane and the retail price of refined sugar by 29% and 30% respectively. It also allowed sugar producers to sell 10% of their output in the open market where prices were much higher. As a result, returns to the industry improved considerably. In fiscal year 1982, the government increased the excise duty on sugar production by about 60% presumably to try and capture some of the gains expected to accrue to the industry as a result of the partial decontrol. The effect of the increase in excise taxes on mill profitability was not, however, felt immediately as most mills qualified for excise duty exemptions due to higher production.

After a succession of good production years and a build-up of stocks, sugar was completely decontrolled in August 1983. As greater supplies became available on the open market the price of sugar fell from Rs. 9.14 per kilogram in 1983 to Rs. 8.12 per kilogram in 1984. Government intervention in the form of timely release of stocks in the open market and the sale of sugar at fixed prices through the Utility Stores also exerted a downward pressure on prices. The delayed effect of the imposition of higher excise duties and the decline in sugar prices appear to have been responsible for the fall in mill profitability in 1983 and 1984.

return on investment and equity for the industry increased to 19.1% and 28.2% respectively in 1986. These returns were obtained despite fairly low capacity utilization rates and if price controls had still been in effect, it is likely that mill profitability would have been severely affected.

3.5.2 Returns to Refined Sugar vs Gur Production

Table 3.11 compares the returns to refined sugar production with gur processing in the Punjab for the year 1986. The net return to growers cum gur producers per maund of cane processed appears to be almost four times higher than the return to refined sugar production though it should be kept in mind that the former includes the return to both cane cultivation and gur processing.

The difference between the net return to growers-cum-gur processors per maund of cane crushed and the return to growers per maund of cane supplied to the mill is Rs. 1.44 (Rs.3.87-Rs.2.43) and represents the additional income derived from gur processing by farmers. This understates the real returns to gur processing as inputs such as labor and bullocks are valued at market rates. In practice, growers utilize family labor and bullocks already owned by them to make gur during a relatively slack period in the year. Since the opportunity costs of both family labor and bullocks are probably lower than the imputed market rates, actual returns to gur production are likely to be higher than estimated.

Table 3.11 also shows that if gur processors had to pay the same prices for cane as refined sugar producers then the net returns to the former would be negative. This seems to account for the apparent absence of any commercial gur production by non-farmers in the Punjab.

The estimated returns to gur and refined sugar processing explain why, at least in the Punjab, gur making as an enterprise has not developed into an industry and yet continues to exist. They also illustrate why it has been so difficult for the formal sector to compete with or displace a supplemental enterprise which uses marginal labor and resources as inputs.

A common perception about gur production is that it is less efficient in terms of sugar recovery than white sugar production. This is based upon the much lower juice extraction rates of gur processors compared with sugar mills. However, in terms of sucrose yield, gur recovery rates have been found to be comparable with those for sugar mills. This is because of two reasons. First, the delays in crushing reduce the sucrose yield from cane at the mills. Second, the higher extraction rates achieved by the latter are largely offset by the subsequent processing where a great deal of sugar is lost in molasses, which has a lower market value.

TABLE 3.11 RETURNS TO WHITE SUGAR AND GUR PROCESSORS IN THE PUNJAB, 1986

	WHITE SUGAR	GROWER/GUR PROCESSOR	INDEPENDENT GUR PROCESSOR [1]
	----------	Rupees	----------
Cane			
Variable cost of production/md [2]	6.07	6.07	6.07
Marketing costs/md	1.87	-	1.87
Prices paid for cane/md	10.37	6.07	10.37
Net returns to growers/md	2.43	-	2.43
Processing [3]			
Variable cost of production/md of product [4]	164.59	102.36	145.80
Fixed cost/md of product	41.8	20.38	20.38
Marketing costs/md of product	-	13.64	13.64
Excise taxes/md of product	80.24	-	-
Total costs/md of product [5]	286.63	136.38	179.82
Revenues/md of product [6]	298.56	175.45	175.45
Net returns to processors/md of product	11.94	39.07	-4.37
Net returns/md of cane processed	1.01	3.87	-0.43
Retail prices/md incl. excise taxes	332.89	210.86	210.86
Retail prices/md excl. excise taxes	252.65	210.86	210.86

[1] This refers to a gur processer who is not a cane grower.

[2] Maund. 1 maund = 40 kilograms.

[3] Sugar processing costs are based on Table 4.7 while gur processing costs are taken from a 1981 USAID/ATDO study on village level food processing, adjusted for inflation using the GDP deflator.

[4] Includes cane costs assuming a recovery rate of 8.5% for sugar and 9.9% for gur.

[5] The value of by-products has been subtracted from processing costs.

[6] Based upon estimated ex-factory prices for sugar and published wholesale prices for gur.

3.6 Policy Issues

The sugar industry in Pakistan has historically operated in a highly regulated environment: it has been subject among other regulations to price and distribution controls, statutory minimum prices for cane, and investment restrictions. More recently, there has been a trend towards deregulation of the industry. This section examines some of the major policy issues relating to the processing sector in the context of this changing policy environment.

3.6.1 Sanctioning Procedures

Until 1987, the sugar industry was included in the list of specified industries for which prior government approval is required before any new investment or expansion of existing capacity can be made.

In practice, the Federal Government made an overall allocation of capacity to the provinces which, in turn, sanctioned individual projects within this allocation. Responsibility for the selection of sponsors and location of mills rested with the provincial government. After the latter's permission had been obtained, loan-giving agencies carried out an appraisal of the project's viability before extending any financial assistance. These procedures for obtaining a sanction for a new sugar mill were cumbersome and time-consuming. There was also a considerable element of arbitrariness in the selection of both sponsors and location at the provincial government level.

In 1987, the GOP removed sugar along with 11 other industries from the list of specified industries. While this is a welcome step, it is unclear at this stage whether it will make much practical difference as the powers of the provincial governments with repect to sanctioning procedures remain unchanged. Also, the fact that financing agencies are in the public sector means that effective sanctioning powers remain with the GOP.

A proposal currently under review is that no prior locational approval be required from the provincial governments for establishing new mills. Under this proposal, the provincial governments would identify and make public a list of suitable locations for setting up new mills. Actual site selection would then be a matter between the entrepreneurs and financing agencies to decide upon and no further reference to the provincial governments would be necessary. This appears to be a step in the right direction though it is desirable that the provincial governments prepare a negative list of areas where, for particular reasons, sugar mills should not be established rather than a positive list of approved sites. This would give entrepreneurs and financing agencies more flexibility in choosing a suitable location for a sugar mill.

3.6.2 Location Policy

Because of its profitability, the increase in cane production as new mills are established is likely to come at the expense of other crops. Therefore, despite the need to simplify sanctioning procedures, the issue of where new sugar production capacity should be located remains an important one. Some of the questions which need to be asked in this regard are : What crops are likely to displaced as cane production increases ? Is this acceptable? What alternatives, if any, are there to these apparent trade-offs? The answers to these questions should determine not only the future location policy for new mills but the degree to which sugar production ought to be encouraged.

The case of Sind, where most of the recent sugar production capacity has been installed, illustrates the potential trade-offs involved. Until now, the increase in cane acreage in the province has been mainly at the expense of IRRI rice. It is likely, however, that further expansion of cane acreage in Sind will come from areas currently under cotton. This suggests that the goal of self-sufficiency in sugar production may be achieved at the cost of a loss in export earnings. While these potential trade-offs need to be examined in greater detail before any firm conclusions are possible, they emphasize the need to increase cane production by improving yields rather than expanding acreage.

3.6.3 Excise Taxes and Exemptions

Excise taxes on mill sugar represent about 27% of total refined sugar production costs and 22% of its retail price. In contrast, there are no excise taxes on gur or shakkar production though the latter are subject to some local taxes such as octroi and market committee fees.

This differential tax treatment has an effect on the relative competitive position of refined sugar and gur processors in both the product and raw material markets. Assuming a sugar recovery rate of 8.5%, the excise tax of Rs. 2.15 per kilogram on sugar raises its production cost by about Rs. 7 per maund of cane processed. The refined sugar industry claims with some justification that they would be able to compete more effectively with gur producers by offering higher prices for cane if this excise tax differential did not exist. The problem is that cane prices are already high relative to other countries and increasing them further may encourage cane production only by displacing other valuable crops.

Under current regulations, the government exempts all sugar production in excess of the previous two years average from the payment of excise taxes. This provides mills with the incentive to process as much cane as they can even, it is alleged, at the

expense of lower recoveries. Mills are reported to start crushing when the sucrose content of cane is low and try to extend their operating period even though recoveries tend to fall towards the end of the season.

Another effect of this excise duty exemption is that it magnifies the fluctuations in production costs and profitability which occur due to changes in capacity utilization rates. In years when capacity utilization rates are high and production costs low, the effective excise tax per unit of production is reduced as mills qualify for the exemption. Conversely, when capacity utilization rates are low and production costs high, costs increase further and profits are squeezed as mills become ineligable to qualify for the excise tax exemption.

Existing tax regulations also exempt new mills from 50% of the excise tax payable by them in the first two years of operation. Others qualify for an income tax holiday for five years, depending on their location. These exemptions give new mills an advantage in acquiring cane compared to older mills. Although these advantages eventually disappear after some years, they have the effect of disrupting the sugar production and marketing process.

There is need to examine the effects of the existing exemptions in the industry. The government may also want to consider the possibility of allowing mills to defer excise tax payments in years of low capacity utilization. This would tend to stabilize prices by moderating fluctuations in production cost.

3.6.4 Quality Premium and Profit Sharing

One of the most serious disincentives to improving cane quality has been the system of cane payment by weight. If farmers are paid by weight they have no incentive to grow improved varieties or adopt cultural practices which give a higher sucrose content.

In order to induce farmers to improve cane quality, the government introduced a new cane payment system in 1981 linked to the sucrose content of cane. The introduction of this new payment system was also motivated by the government's desire that growers get a share of the mills' profits. The main feature of this new system was that the mills had to pay growers a bonus or premium if the sugar recovery rate over the entire season was above a specified percentage. At present, this 'quality premium' is Rs. 0.14 per maund for every 0.1% excess recovery above 8.3% in the NWFP, 8.5% in the Punjab and 8.7% in the Sind. As these recovery rates have been exceeded only by the Sind sugar industry, the main beneficiaries of the quality premium have been the cane growers in Sind.

The quality premium as it exists today seems more an indirect method of increasing the price received by growers for cane than an incentive to improve cane quality. This is because the quality premium is based on the average mill recovery over the entire crushing season and not the amount of recoverable sugar in the cane supplied by an individual farmer. Because of the problem of the 'free rider,' the latter still has little incentive to improve cane quality. The introduction of a quality premium based upon the actual sucrose content in a farmer's cane was apparently precluded by the practical difficulties involved in such an approach. These included problems of measurement, administration, and also cost.

Two public sector mills have recently been instructed by the government to install 'core samplers' which are reported to provide a cheap and efficient method of determining the amount of recoverable sugar in a sample of cane. While this appears to be a promising development, the results of this experiment were, at the time of writing this report, unknown.

3.6.5 The Level of Import Duties

The average C&F price of imported refined sugar in 1986 was Rs 3.52 per kilogram. Since the estimated ex-factory cost in Pakistan excluding excise taxes was Rs 5.17 per kilogram, the domestic production cost of sugar was 47% higher than its import cost. If excise taxes are included, local production costs were almost double the import cost in 1986. It should, however, be kept in mind that international sugar prices are distorted by subsidies provided by sugar exporting countries and therefore import prices do not necessarily reflect the production costs of other countries.

Nevertheless, since international prices are below Pakistan's production costs, the government has imposed a specific customs duty on sugar imports to protect the domestic sugar industry. Current government policy appears to be to set import duties at a level that will ensure that the sugar industry as a whole earns an after tax return on equity of at least 20 %. The fact that the industry earned a return on equity of nearly 30% in 1986 suggests that the level of import duties may be somewhat high.

One effect of the fixed import duty on sugar is that the degree of protection provided to the domestic sugar industry varies as international prices change. This means that, given the volatility of international sugar prices, frequent revisions of the import duty would be required to maintain a particular level of protection to sugar production. Alternatively, the government could impose a variable levy on sugar imports so that its landed cost does not exceed a specified target level. This would

eliminate the need for frequent mid-year revisions in import policy in order to provide a uniform level of protection to the sugar industry. The variable levy could be revised every year in light of changing international and domestic circumstances.

3.6.6 Lending Policies

New mills are normally financed by banks in the debt-equity ratio of 70:30. However, because of the availability of bridge financing until the public issue of shares by the company, the sponsor's initial contribution in a typical sugar mill project may be as little as 20% of total investment costs. Since all the lending institutions financing sugar mills are state owned, a disproportionate amount of risk is borne by the public sector.

High leverage levels result in large fixed operating costs and consequently higher breakeven points for new mills. The latter therefore are under pressure to process as much cane as possible. At the same time, existing tax regulations enable new mills to offer, at least initially, much higher prices for cane than older mills. For a variety of reasons, therefore, these mills instead of devoting time and attention to developing cane in their own area are more likely to engage in cut throat competition with other mills for the exisiting cane supply.

High debt-equity ratios also encourage the entry of entrepreneurs with little interest in the long-term development of the industry. These entrepreneurs are likely to pay less attention to building up their businesses than those with more substantial investments at stake in the industry. One possible solution may be to finance groups of farmers to set up sugar mills as cooperative or corporate ventures. Unlike other entrepreneurs, these farmers can be expected to be interested in cane development as well as processing profits.

Like other industries, the sugar industry currently qualifies for low interest loans for purchasing locally manufactured machinery. These loans are available at an interest rate of 6% per year and are designed to promote the development of a domestic capital goods manufacturing capacity rather than specifically encourage sugar processing. It is difficult to justify these subsidized loans since the profitability of sugar mills seems high enough to attract investment capital as demonstrated by the continued growth in constructed capacity.

3.6.7 Additional Capacity Requirements: New vs Expansion

By 1990, the demand for sugar will be higher than the existing and planned production capacity in the country. If additional capacity is considered necessary, it raises the question whether

this should be achieved by setting up new mills or, to the extent possible, by expansion of existing factories.

Although precise estimates are not available, expanding existing mills is likely to cost a fraction of the expenditure required to establish a new mill. This is because the substantial investments in infrastructure involved in setting up a new sugar mill project would not be necessary. However, while a case for meeting additional capacity requirments by expanding existing processing facilities can be made on financial grounds, this has to be balanced against other considerations such as the wider distribution of ownership and the concentration of market power.

3.6.8 Research and Development

Present research activities in both the public and private sectors are inadequate and poorly coordinated. The government research effort in particular is constrained by a lack of resources and poor linkages with the industry and government extension agencies.

The need for a specialized sugar research institute is by now well recognized by both policymakers and the industry. It is important, however, that the industry actively participates in the establishment and running of such an institute. A current proposal being considered by the government plans to locate the proposed institute in the Ministry of Food, Agriculture and Cooperatives. For the reasons discussed earlier it is believed that the absence of any meaningful industry involvement is likely to considerably reduce the effectiveness of this institute.

A better approach would be to set up an independent sugar research institute along the lines recommended by a FAO study in 1974. This institute would be financed from the cane development cess (which could be enhanced if considered necessary) and matching funds from the government. Control of the institute would be vested in an executive board composed of government, industry and growers representatives.

3.6.9 Cane Support Prices and Sugar Production Costs

Sugar production costs are highly sensitive to changes in the support price of cane. This is hardly surprising since cane accounts for almost half of total sugar production costs. The increase in the cane support price from Rs. 9 per maund to Rs 11 per maund in 1986-87, for example, is likely to increase sugar production costs by Rs 0.63 per kilogram assuming a recovery rate of 8.5%.

This highlights the fact that in setting minimum support prices for cane, policy makers have to strike a balance between maintaining sufficient incentives to growers, adequate returns to the sugar industry, and low prices for consumers.

3.7 Summary and Recommendations

The sugarcane processing sector in Pakistan is fairly efficient and the high cost of sugar is basically a reflection of the high cost of cane and its poor quality. While the efficiency of mills varies greatly, processing costs on average are not a major contributory factor to the high cost of sugar.

Even the cottage sector, which is often viewed as inefficient, appears to be an effective low cost producer of sweeteners because it is based upon the utilization and employment of resources already on the farm and with little or no opportunity costs. As incomes increase and consumption patterns change, however, future growth in sweetener production is likely to come increasingly from the expansion of the refined sugar industry.

At present, the growth of the refined sugar industry is constrained by the agricultural sector which is characterized by stagnant production and low yields. Various regulations and policies exist which influence the way in which sugar processing businesses operate. At the same time, while considerable deregulation of the sugar industry has taken place, it is still subject to various controls which, although not significant are not necessary either. It is in this context that the following recommendations are made:

(a) The remaining investment controls on the sugar industry should be removed. No prior sanction should be required from the provincial governments for establishing new mills.

(b) Provincial governments should prepare a 'negative' list of areas where sugar mills should not be established and entrepreneurs should be free to set up mills in any area not on this list, in consultation with financing agencies.

(c) Sugar mills should be exempted from the present ceiling on land ownership and allowed to own upto 2000 acres of land for the establishment of model farms. These farms can be be used for experimental purposes as well as for seed production and improvement.

(d) An autonomous sugar industry research institute should be established with strong industry participation. This industry should be funded from the cane development cess, which could be enhanced if considered necessary, and from matching government funds.

(e) A cane payment system based upon the individual sampling of farmers' cane should be introduced as soon as possible.

(f) New mills should be financed in lower debt-equity ratios to ensure that the sponsors have a significant stake in the industry and that risk bearing is shared equally by the private and public sectors.

(g) The possibility of financing cooperative or corporate ventures in the sugar industry with mills owned either wholly or partly by growers should be examined.

(h) The existing level of excise duty as well as the various exemptions available to the sugar industry should be re-evaluated to assess their effect on production incentives and efficiency.

(i) Low interest loans to the sugar industry for purchasing domestically manufactured machinery should be discontinued.

4. INTERNATIONAL ASPECTS OF THE SUGAR INDUSTRY

4.1 Characteristics of the World Sugar Economy

Sugar is considered a basic food commodity and is produced throughout the world. Production from sugarbeets represents about 40% of the supply and sugarcane is the raw material for the remaining 60%. Sugarbeets are grown mostly in temperate climates while sugarcane tends to be cultivated in tropical and subtropical areas of the world.

4.2 World Sweetener Consumption

The consumption of sugar is determined by its price, the prices of substitute products, level of consumer income, and the internal and trade policies of countries. The per capita consumption in industrial countries appears to reach saturation at 45 to 55 kilograms. Production and consumption in these countries are not related because of government interferences in the market to benefit special interest groups. In developing countries the production of sugar greatly influences consumption. Per capita consumption in developing countries that have net exports of sugar reaches 30 to 70 kilograms per capita. Developing countries that are net importers tend to have low per capita consumption of 5 to 10 kilograms.

Sugar's share of the sweetener market has declined since 1975 mostly due to use of high fructose corn syrup in soft drinks and in bakery and confectionary industries. Sugar's market share in world trade fell from 96% in 1975 to 91% in 1984. However, in the U.S., sugar represents less than half of total sweetener consumption. Between 1980-1986 there was a 23 % reduction in sugar consumption and an increase of 77% in corn sweetener consumption.

As Table 4.1 shows, world sugar consumption during the period 1976-1986 varied from a low of 79.2 million metric tons in 1976 to a high of 98.0 million metric tons in 1986. The change in consumption from the previous year varied from a decrease of 1.0 million metric tons between 1980-81 to an increase of 4.4 million metric tons between 1976-77. Table 4.2 presents consumption, production and trade data by geographical region for the years 1985 and 1986. The most important consumption regions of the world in 1985/86 were Asia (26.1 million metric tons), the U.S.S.R. (13.3 million metric tons), North America (12.0 million metric tons) and the European Economic Community (11.7 million metric tons).

FIGURE 4.1 SUGAR: WORLD PRODUCTION, CONSUMPTION AND STOCKS, 1972-86

Crop Year beginning September	Production				Consumption		Ending stocks		Ending stocks as a % of consumption
	Cane	Beet	Total [1]	Change from previous year	Total	Change from previous year	Total	Change from previous year	
	Million metric tons, raw value								
1975-76	49.9	31.7	81.7	3.2	79.2	2.1	21.0	2.1	26.5
1976-77	53.5	32.8	86.3	4.6	81.9	2.7	24.8	3.8	30.3
1977-78	57.7	35.0	92.7	6.4	86.2	4.3	30.0	5.2	34.8
1978-79	56.7	34.6	91.3	-1.4	89.6	3.4	31.0	1.0	34.6
1979-80	51.1	33.5	84.6	-6.7	89.5	-0.1	24.2	-6.8	27.0
1980-81	55.6	32.9	88.5	3.9	88.5	-1.0	24.2	0.0	27.3
1981-82	63.6	37.0	100.6	12.1	89.4	0.9	34.0	9.8	38.0
1982-83	64.0	37.3	101.3	0.7	93.8	4.4	41.4	7.4	44.1
1983-84	60.9	35.8	96.7	-4.6	95.9	2.1	42.2	0.8	44.0
1984-85	63.1	37.6	100.7	4.0	96.8	0.9	45.7	3.5	47.2
1985-86 Estimate	60.7	37.3	98.0	-2.7	98.0	1.2	46.2	0.5	47.1

[1] May not add because of rounding.

Source : Foreign Agricultural Service, USDA

FIGURE 4.2 WORLD SUGAR PRODUCTION, CONSUMPTION, AND IMPORTS BY REGION, 1984/85 AND 1985/86

Region	Production				Consumption		Imports	
	1984/85		1985/86					
	Cane	Beet	Cane	Beet	1984/85	1985/86	1984/85	1985/86
	Million metric tons, raw value							
North America	6.1	2.7	6.3	2.7	12.0	12	3.6	3.2
Caribbean	9.7	0	8.1	0	1.4	1.5	0.2	0.1
Central America	1.8	0	1.8	0	0.9	1	0	0
South America	14.2	0.3	12.8	0.3	10.8	10.9	0.4	0.3
European Community	0.0	14.4	0.0	14.4	11.7	11.5	3	3.0
Other W. Europe	0	1.1	0	1.0	1.3	1.3	0.5	0.5
Eastern Europe	0	5.6	0	5.4	6.2	6	1.2	1.0
USSR	0	8.5	0	7.8	13.3	13.3	5.3	5.5
North Africa	1.2	0.5	1.3	0.5	3.7	3.7	2.2	2.1
Other Africa	6.0	0	5.9	0	4.3	4.3	0.9	1.0
Middle East	0.2	2.2	0.2	1.8	5.1	5.2	2.8	2.8
Asia	19.7	1.6	20.3	1.3	25.1	26.1	7.4	7.4
Oceania	4.0	0	3.8	0	1.0	1	0.2	0.2
World total	63.1	37.2	60.8	35.6	96.8	98.0	27.7	27.1

Source: Foreign Production Estimates Division, Foreign Agricultural Service, USDA

Both income and price elasticity of demand for sugar in industrial countries are relatively low. The income elasticity of per capita demand averaged about 0.2 over the past 15 years for these countries. However, the income elasticity for developing countries where per capita consumption was above 30 kilograms was about 0.7. Elasticity is around unity for countries with low consumption levels. It appears that the saturation levels are higher for developing country consumers than for consumers in industrial countries. The fact that sugar is a cheap source of human energy and is used as a substitute for other food products may explain the differences in saturation levels. Income and price elasticities for sugar consumption in Pakistan have been estimated at 0.8 and -0.4, respectively. These estimates are discussed in detail in section 5.2.2 of this report.

According to World Bank projections (See Table 4.3), world sugar consumption is expected to increase by 1.8% per year between 1985 and 2000. Consumption in industrial countries is projected to grow by 0.8% annually while developing country consumption is expected to be about 2.1% per year. The growth rate of per capita consumption in Pakistan is projected to be about 3.3% if past trends continue (see Section 5.2.3), which is higher than the developing country expected average.

4.3 World Sugar Production

Sugarbeets are an annual crop and producers can respond to price changes within one to two years. On the other hand sugarcane can be ratooned for three to five years (in Pakistan usually only one to two ratoon crops are taken) before being replanted. Cane production can be responsive to price increases by applying more fertilizer or planting additional acreage. However, since cane can be harvested annually or biannually without replanting for several years, production response to price decreases is relatively prolonged.

World production averaged 88.7 million tons between 1979-1981 and in 1986 it was about 100 million tons. The largest sugar producing countries are the USSR, Brazil, Cuba and the US, which together account for nearly one-third of total world sugar production. World Bank projections indicate that world sugar production is expected to grow by 1.9% per year during 1985-2000. As a result, total sugar production is projected to increase to about 111 million tons in 1990 and 132 million tons by 2000. The annual growth rate of production for developing countries is expected to be 2.7% per year. The industrial countries are projected to increase sugar production by 0.4% per year between 1985 and 2000 while centrally planned economies are projected to increase production by 0.9% per year during this period. Production projections for Pakistan's sugar industry are discussed in section 5.2.3 of this report.

TABLE 4.3 ACTUAL & PROJECTED TRENDS IN WORLD SUGAR PRODUCTION, CONSUMPTION AND TRADE [1]

Countries/ Economies	Actual		Projected		Growth Rates [3]
	1979-81	1985 [2]	1990	2000	1985-2000
	Million tons				% per annum
Production					
Industrial	25.8	25.8	25.8	27.3	0.4
Centrally Planned	11.4	13.5	14.5	15.5	0.9
Developing	51.5	59.7	70.8	88.7	2.7
World	88.7	99.0	111.0	131.5	1.9
Consumption					
Industrial	27.6	25.0	26.5	28.4	0.8
Centrally Planned	16.5	18.5	20.1	26.3	2.4
Developing	44.0	54.7	64.0	74.2	2.1
World	88.1	98.2	110.6	128.9	1.8
Gross Exports					
Industrial	8.5	9.2	9.5	10.2	0.7
Centrally Planned	0.7	0.8	0.7	0.9	0.1
Developing	18.7	18.9	20.0	27.4	2.5
World	27.9	28.9	30.3	38.5	1.9
Gross Imports					
Industrial	10.3	9.1	10.4	12.2	2.0
Centrally Planned	5.7	5.5	6.5	12.3	5.5
Developing	11.3	14.1	13.4	14.1	0.0
World	27.3	28.7	30.3	38.5	2.0

[1] Centrifugal sugar, raw equivalent

[2] Estimate

[3] Least squares trend for historical period, end-point for projected period.

Source: World Bank, 1986

4.4 World Trade in Sugar

It has been estimated that more than two-thirds of world sugar consumption is traded under price policies that shield from international price movements. Although sugar is produced in nearly all countries, world trade in sugar amounts to a relatively large share of total production (25-30 %). Between one-third to one-half of this trade is conducted under special arrangements such as the US Sugar Quota Imports program, the Sugar Protocol of the Lome'Convention between the EEC and the ACP countries, the Cuba-Russia sugar protocol, and various bilateral long-term agreements under fixed pricing.

Countries are anxious to maintain at least some production of sugar domestically because sugar is a basic food. Also sugarcane is a crop that gives relatively high returns to farmers on a per hectare basis and it requires a large labor input. This provides more employment per hectare than most alternative crops. In sum, for countries with abundant labor and scarce foreign exchange, sugar cultivation offers the advantages of employment creation, high returns, and foreign exchange savings.

With increasing import-substitution on the one hand by countries expecting domestic consumption growth, and diversification away from sugar on the other hand by traditional sugar-exporting countries in the Caribbean and in Latin America, the long-term outlook is for slower growth in world trade. World gross imports are projected to grow at an average annual rate of 2.0% per year (from 29.0 to 38.0 million) tons between 1985 and 2000. The highest rate of growth of 5.5% is projected for the CPEs where imports will largely be from Cuba. The lowest projected rate of growth in imports is -1.4% per year for developing Asia.

World gross exports are projected to grow at 1.9% per annum --from 29.0 million tons in 1985 to 38.5 million tons in 2000. The export share for all industrial countries will decrease from 32% to 26%. Gross exports from developing countries are projected to grow at 2.5% per year. The developing countries' exports share of world exports is projected to increase from 65% to 72% between 1985 and 2000.

4.5 World Sugar Prices

International market prices have exhibited great variability over time. The causes for these wide fluctuations are: (1) production variability due to climatic conditions and pests; (2) protectionist policies of both sugar producing and consuming countries, and (3) changes in consumption. Because of policies to isolate

domestic markets from world events, sugar price adjustments are transferred onto the international market rather than being absorbed in quantity changes in originating markets.

As Table 4.4 shows, within the past 15 years there have been two "roller coaster" price movements. The first price peak occurred in 1974 when prices averaged $653.9 per ton and declined to $172.0 average per ton by 1978. The second price peak occurred in 1980, when prices zoomed to $632.0 per ton average and then fell over a five-year period to $90.2 per ton average in 1985.

The continuing downturn after 1980 was due to increasing world stocks as consumption increased slowly and production increased because of high price supports in various countries. World stocks increased from 21.6 million metric ton in 1973 to about 46 million metric tons in 1985. Since 1985, prices have gradually risen and are expected to continue this trend and reach an average price in current dollars of $390.0 by 1990. Prices are projected to decline to $380.0 in 1995 and spike to $430 per ton in 2000.

The typical pattern for world sugar prices has been for a 4 to 6 year period of depressed prices, followed by a price spike lasting from 12 to 18 months. In the future, this pattern may be changed because of the increased production capacity of importing countries or planned expansion of fuel ethanol production in many sugar-exporting nations. This alternative outlet for sugarcane allows sugar production to be diverted for fuel ethanol production in times of low sugar prices. If sugar prices rise, more cane can be returned to sugar production. Consequently, future world sugar prices might not follow the earler price cycle because of faster production responses to changes in world sugar prices. As oil prices decline the incentive to develop ethanol production rapidly decreases.

Free market sugar prices are expected to remain below cost of production for most countries. There could be a boom in prices near 1990 which could encourage countries with high consumption to increase consumption of HFCS.

The price of sugar in Pakistan has been well above world prices since 1979 (See Table 4.5). This has led to debate over the issue of government price policies and the tradeoff between importing or production. On the other hand, if Pakistan does not maintain a significant capacity it becomes vulnerable to the wide price fluctuations in world prices.

TABLE 4.4 SUGAR: PRICES, 1960-85 (ACTUAL) AND 1986-2000 (PROJECTED) [1]

	CURRENT $	1985 CONSTANT $	
		MUV [2]	US GNP [3]
	Dollars per ton		
Actual			
1960	69.2	230.0	232.2
1961	59.5	194.4	198.3
1962	61.3	197.1	200.3
1963	183.9	601.0	593.2
1964	127.2	407.7	403.8
1965	44.5	141.7	138.2
1966	39.9	122.4	119.8
1967	42.3	128.6	123.7
1968	41.9	128.1	117.4
1969	70.6	205.8	187.8
1970	81.1	222.2	204.8
1971	99.2	257.7	238.5
1972	160.3	382.6	370.2
1973	208.3	428.6	454.8
1974	653.9	1104.6	1313.1
1975	449.1	682.5	824.0
1976	254.9	382.2	444.9
1977	179.0	244.2	294.9
1978	172.0	204.0	264.2
1979	213.0	223.0	300.9
1980	632.0	603.6	817.6
1981	374.0	355.5	441.6
1982	185.6	178.8	206.7
1983	186.7	184.9	200.3
1984	115.0	115.8	118.8
1985	90.2	90.2	90.2
Projected			
1986	154.0	136.6	149.8
1987	187.0	160.9	173.8
1988	253.0	214.4	223.7
1989	316.0	264.4	265.8
1990	390.0	322.5	312.0
1995	380.0	265.3	248.9
2000	430.0	253.1	230.7

[1] "World" (ISA Daily) Price, FOB and Stowed Main Caribbean Ports.
[2] Deflated by Manufacturing Unit Value (MUV) Index.
[3] Deflated by US GNP Deflator.

Source: World Bank, 1986

TABLE 4.5 RATIO OF DOMESTIC SUGAR PRICES TO INTERNATIONAL MARKET PRICES [1]

Year	Wheat	Rice		Lint Cotton	Sugar
		Basmati	Irri		
	%age				
1980	113	58	89	99	99
1981	109	67	80	88	139
1982	102	68	90	114	200
1983	114	64	113	95	135
1984	94	67	114	83	142
1985	103	58	102	91	164
1986	107	57	124	111	156

[1] Procurement prices in Pakistan plus handling and transport charges to Karachi, as ratio of FOB export prices for cotton and rice, and CIF import prices for wheat and sugar.

Source: Pakistan Economic Survey

5. SWEETENER DEMAND AND SUPPLY ANALYSIS

5.1 The Pakistan Sweetener Sector

5.1.1 Introduction

Sugarcane is Pakistan's second most important non-foodgrain crop after cotton and is the source for virtually all the sweeteners domestically produced. Although it occupies only 3.9% of the total cropped area, sugarcane accounts for 10.5% of the gross value added by all crops. Sugarcane is grown in the Punjab, Sind and NWFP, with the Punjab and Sind accounting for most of the acreage and production. To encourage production, the GOP has held sugarcane and sugar prices at relatively high levels compared to international or import prices. High domestic sugar prices have been maintained by a government monopoly and, later, regulatory duty on imported sugar.

Sugarcane is processed by sugar mills into refined sugar and by farmers and other cottage scale processors into gur, shakkar and desi sugar. The cottage sector and sugar mills both compete for the available sugarcane supply and domestic sugar production is largely determined by the amount of sugarcane available to the sugar mills. Small amounts of sugar are produced from sugarbeets and some corn syrups and glucose based sweeteners are also manufactured, but these add little to the overall sweetener supply. The mill sector processes only half of the total sugarcane produced in the country. Inspite of this, it is a major industry ranking only behind textiles in size and producing about 7.4% of the total value of manufacturing output.

The refined sugar produced by sugar mills is sold to consumers as well as to industry where it is used in the manufacturing of soft drinks, confectionery, and bakery products. Gur is mainly sold to consumers or is used by farmers-processors themselves. Sugar and other sweeteners are an important component of consumer diets: expenditures on these represent nearly 7% of the total household expenditures on food and 3.5% of total household consumption expenditures. Refined sugar, in particular, is regarded as a basic or essential commodity and shortages or sudden increases in its price have sometimes produced strong consumer reactions in the past.

Because of the sensitive nature of the product, government interventions in the refined sugar market have been the rule rather than the exception. Throughout the 1970s, the GOP imposed price and distribution controls on refined sugar and operated a ration system to distribute sugar to urban consumers at fixed retail prices. Since the ration system for refined sugar was abolished

in 1983, the GOP has used imports to defend, in effect, a target ceiling price. In contrast, there have been virtually no government controls on the production and distribution of gur, shakkar, and desi sugar.

Sugar imports are required whenever domestic production and carryover stocks are below expected consumption. This has been the case roughly every five years when the sugarcane crop has been ruined by dry weather or pests. In recent years consumption of refined sugar has grown faster than in the past when the ration system held back consumption. At the same time, domestic sugar production has declined since 1981-82 with some recovery in 1986-87 and 1987-88. This has put upward pressure on sugar retail prices and necessitated large imports. The inability of domestic production to keep pace with consumption has been due to stagnation in sugarcane production. This is a cause for some concern since the support prices for sugarcane are already fairly high relative to other countries.

5.1.2 The Sugar Demand and Supply Balance

The total available supply of refined sugar in any year is made up of domestic production, imports and carryover stocks. Domestic consumption and exports represent the total usage or "disappearance" of sugar and the balance remaining comprises closing stock or next year's carryover stock. Domestic sugar production represents most of the Pakistan sugar supply and is largely determined by the amount of sugarcane crushed by the mill sector. The latter in turn depends mainly upon the size of the sugarcane crop, the prices offered by mills for cane relative to those of gur, and the expansion of crushing capacity installed in the country.

Figure 5.1 shows trends in sugar production and consumption over the period 1962-87 while statistics on the Pakistan sugar demand and supply balance over the same period are presented in Table 6.1.

Sugar production increased by about 9.8% per year over the period 1962-87. However, this growth was marked by considerable year-to-year fluctuation. For example, production fell from 519,000 metric tons in 1971 to 375,000 metric tons in 1972 and again from 861,000 metric tons in 1978 to 607,000 metric tons in 1979. Both 1981 and 19[illegible] were exceptionally good production years which allowed large stocks to be built up. Throughout this period the availability of sugar grew at roughly the same rate as domestic production. Since 1982, sugar production has stagnated due to stagnation in sugarcane production. In 1987, sugar production was approximately 1.3 million metric tons, no higher than what it was in 1982.

FIGURE 5.1 PRODUCTION AND CONSUMPTION OF SUGAR IN PAKISTAN, 1962-87

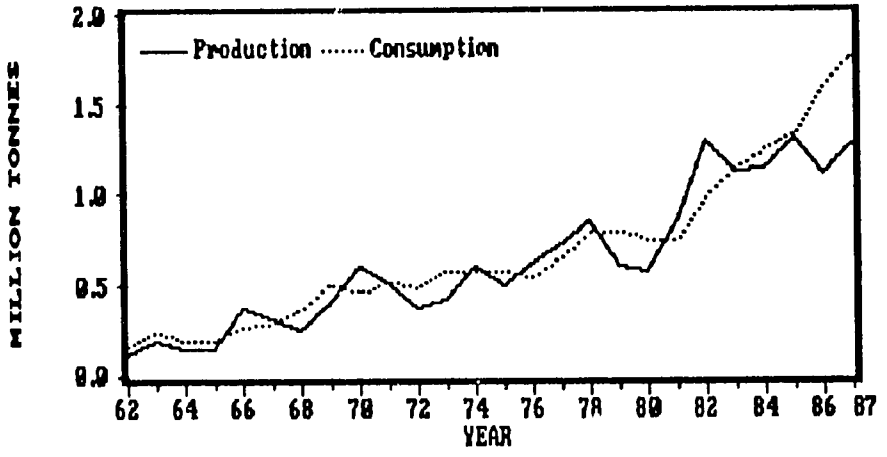


Table 5.1 PAKISTAN SUGAR SUPPLY AND USAGE BALANCE, 1962 TO 1987

FISCAL YEAR	BEGIN-NING STOCKS	PRO-DUCT-ION	IMPORTS	TOTAL AVAILABLE SUPPLY	DOMESTIC CONSUMPT-ION	EX-PORTS	TOTAL USAGE	ENDING STOCKS
				(000 METRIC TONS)				
1962	10.2	124	78.1	212.3	162.1	9.9	172.0	40.3
1963	40.3	203	85.2	328.5	240.7	0.0	240.7	87.8
1964	87.8	157	0.6	245.4	188.8	0.1	188.9	56.5
1965	56.5	159	34.3	249.8	196.2	0.1	196.3	53.5
1966	53.5	377	1.1	431.6	267.1	9.6	276.7	154.9
1967	154.9	322	0.3	477.2	289.5	49.0	338.5	138.7
1968	138.7	252	16.5	407.2	365.2	0.0	365.2	42.0
1969	42.0	408	227.3	677.3	505.3	7.7	513.0	164.3
1970	164.3	610	6.9	781.2	454.7	19.9	474.6	306.6
1971	306.6	519	0.3	825.9	516.6	144.2	660.8	165.1
1972	165.1	375	11.2	551.3	484.8	0.0	484.8	66.5
1973	66.5	429	202.7	698.2	577.1	0.0	577.1	121.1
1974	121.1	608	44.9	774.0	569.1	0.0	569.1	204.9
1975	204.9	502	NS	706.9	578.0	0.0	578.0	128.9
1976	128.9	630	[illegible]	758.9	537.2	0.0	537.2	221.7
1977	221.7	736	0.2	957.9	651.7	0.0	651.7	306.2
1978	306.2	861	0.4	1167.6	780.3	0.0	780.3	387.3
1979	387.3	607	1.0	995.3	791.9	0.0	791.9	203.4
1980	203.4	586	100.5	889.9	744.4	0.0	744.4	145.5
1981	145.5	851	70.6	1067.1	740.0	0.0	740.0	327.1
1982	327.1	1301	0.2	1628.3	975.8	0.0	975.8	652.5
1983	652.5	1127	3.3	1782.8	1136.9	NS	1136.9	645.9
1984	645.9	1145	0.3	1791.2	1243.5	49.4	1292.9	498.3
1985	498.3	1306	0.0	1604.3	1325.8	0.0	1325.8	478.5
1986	478.5	1116	258.2	1852.7	1593.5	0.0	1593.5	259.2
1987	259.2	1268	749.5	2294.7	1762.7	0.0	1762.7	532.0

Source : Federal Bureau of Statistics

Total domestic sugar consumption is estimated to have grown at an average rate of 10% per year from 162,000 metric tons in 1962 to about 1.75 million metric tons in 1987. In per capita terms annual sugar consumption is estimated to have risen from 3.4 kilograms in 1962 to 17.5 kilograms in 1987.

Actual sugar consumption is likely to be somewhat lower than indicated in Table 5.1. This is because consumption is derived as a residual from total available supply and closing stocks plus exports. However, the data on stocks relate only to sugar held by mills or in government bonded warehouses on which excise taxes and import duties have not been paid. To the extent, therefore, that they understate the total quantity of sugar stocks held by both the public and private sectors, the estimates derived from them overstate the consumption of refined sugar. Industry experts put current (1987) consumption at about 1.7 million metric tons or 17 kilograms in per capita terms.

The growth in consumption over the last 25 years has been due to increases in population, higher direct per capita consumption of refined sugar by households, and growing consumption of soft drinks, confectionery and other products in which sugar is a major ingredient. This growth in consumption has been made possible by the greater availability of refined sugar, increased purchasing power of consumers due to rising incomes, and constant or declining real sugar prices (See Section 6.14). Sugar consumption has grown particularly rapidly since the early 1980s when price and distribution controls on sugar were lifted and rationing was discontinued.

Since the growth in sugar consumption has exceeded domestic production in recent years, the resulting gap has been met through a drawdown of stocks and through imports. End-of-year stocks fell from 652,000 metric tons in 1982 to as low as 259,000 metric tons in 1986, barely enough for about 1.8 months consumption. Stocks built up again to 532,000 tons in 1987 as large imports were made during that year. Substantial imports have been necessary roughly every five years to meet domestic production shortfalls. In recent years, imports have permitted the availability of sugar to grow despite little or no growth in domestic production. They also seem to have been particularly important in keeping down what otherwise would have been sharp price increases in years of low production.

5.1.3 Production of Gur and Other Open-Pan Sweeteners

Nearly 40% of the total sugarcane produced in Pakistan is processed into gur, shakkar and desi sugar or what are collectively termed "open-pan" sugars. These sweeteners are mainly made by sugarcane growers themselves, mostly for their own use. Some open-pan sugars are also made commercially in small cottage scale

processing units. Gur is cane juice solidified by heating in a large open pan. Shakkar is basically a more powdery form of gur obtained by boiling the cane juice for a longer period in the open-pan. Desi sugar is semi-refined sugar produced by hand driven centrifugal machines. It is usually yellowish brown in colour. In the case of all three sweeteners, the cane juice is first extracted using locally manufactured animal driven presses. Electric power driven crushers are also sometimes used by commercially oriented processors.

Gur and shakkar are the more important of the open-pan sugars and are reported to account for nearly 85% of the total production of open-pan sugars. Gur production is more common in the NWFP and Punjab. One ton of sugarcane yields approximately 100 kilograms of gur. Most of the gur is consumed directly by rural households or used to make traditional candies. Some gur is also fed to livestock. Small quantities of gur have sometimes been used as a raw ingredient for the production of refined sugar. No information is available on what proportion of gur production is consumed during the year or goes into stocks.

The production of gur and other open-pan sweeteners is determined by the amount of sugarcane not crushed for sugar or used for chewing and livestock feed. Official estimates of open-pan sweetener production are in gur equivalent terms and are derived by subtracting from total sugarcane production, the cane used for refined sugar production, an allowance for seed, chewing, livestock feed and wastage and then applying a recovery factor to the resulting figure. It is assumed that 15% of the total cane crop is used for purposes other than sugar or gur production or is accounted for by post harvest losses.

Official estimates of gur production are based on a constant gur recovery factor. In practice, however, this rate is likely to vary from year to year depending upon the sucrose content of the cane. In order to obtain more realistic estimates of gur production, therefore, this study derived gur recovery rates for the period 1962-87 by using the relationship between the "average" recovery rate for gur and for sugar and information on actual sugar recoveries. The trend in the production of open-pan sweeteners in gur equivalent terms based on these recovery rates is shown in Figure 5.2 and its corresponding table.

There are no statistically significant trends in open-pan sweetener production over the period 1962-80. A glance at Table 5.2, however, shows that production increased until 1980 and then declined quite sharply. Between 1980 and 1987, the production of these sweeteners fell by almost 50%. The decline in the production of gur, shakkar and desi sugar can be attributed to increasing consumption of refined sugar (see Section 5.1.6) and a reduction in the quantity of cane available for other sweeteners as a larger proportion was used by mills to produce refined sugar.

FIGURE 5.2 PRODUCTION OF GUR AND OTHER OPEN-PAN SWEETENERS, 1962-87

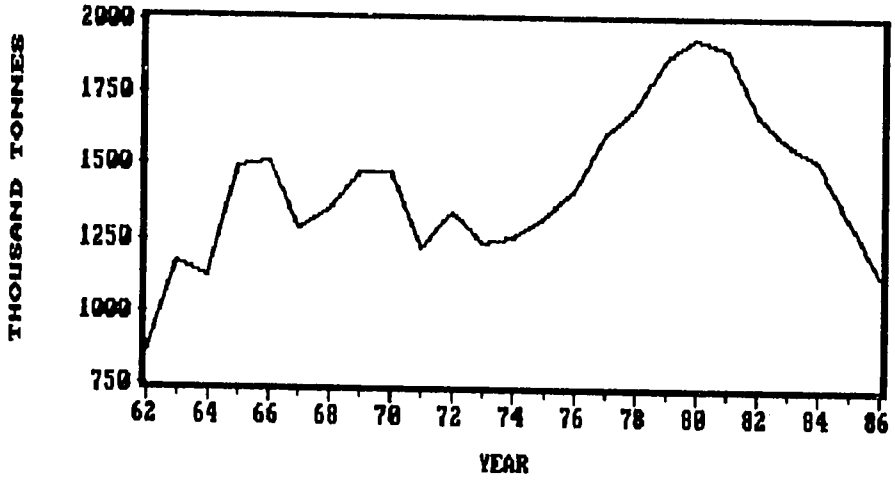


TABLE 5.2. GUR EQUIVALENT PRODUCTION, 1962-87

Year	(000 MT)
1962	856
1963	1168
1964	1122
1965	1496
1966	1517
1967	1285
1968	1352
1969	1473
1970	1475
1971	1216
1972	1340
1973	1241
1974	1257
1975	1322
1976	1419
1977	1613
1978	1704
1979	1874
1980	1945
1981	1905
1982	1685
1983	1580
1984	1519
1985	1321
1986	1134
1987	1115

Source: Chemonics

While the production of open-pan sweeteners still represents nearly half of total domestic sweetener production, the decline in their relative importance is unmistakable and is corroborated by household expenditure surveys which show decreasing consumption of these sweeteners over time. Interestingly, household expenditure surveys show much lower consumption of open-pan sweeteners, and hence of total sweetener consumption. than one would expect from the production estimates derived. This difference is likely to be due, in part, to the indirect consumption of gur as candies or as livestock feed. It may also reflect, however, underestimation of the direct household consumption of open-pan sweeteners by consumer surveys.

5.1.4 Long Term Trends in Sugar and Gur Prices

Trends in nominal and deflated retail sugar prices over the period 1962-86 are shown in Figure 5.3 and its related table. While the nominal price of sugar increased at an average rate of about 8.5% per year, in real terms, refined sugar prices have declined by about 0.8% per annum since 1962.

Throughout much of this period, sugar prices have been determined by the GOP. The principal means used to accomplish this have been direct price and distribution controls on refined sugar and a government monopoly on sugar imports. Since derationing in October 1983, market forces have played a larger role in determining sugar prices. The GOP continues to influence sugar prices, however. It sets the import duty on refined sugar. It also directly imports sugar on public account, a part of which is then sold to consumers at fixed prices through government-owned "utility stores."

Movements in nominal and deflated wholesale gur prices over the same period are shown in Figure 5.4 and its associated table. Nominal gur prices have increased by about 9.5% annually. In real terms, however, gur prices have remained more or less constant. There appear to be no significant trends in real gur prices over the period 1962-87.

Both nominal and real gur prices exhibit a distinct 3- to 4-year cycle. This phenomenon is apparently related to variations in cane acreage and output which also follow a similar, though less pronounced, cycle. Years of high gur prices seem to be associated with those of low cane production while low gur prices are related to those of peak cane production. The cyclical variations in cane acreage and production in turn appear to be due to the practice of ratooning, because of which planting decisions in one year affect acreage and output in the following two to three years.

FIGURE 5.3 NOMINAL AND DEFLATED RETAIL SUGAR PRICES, 1962-86

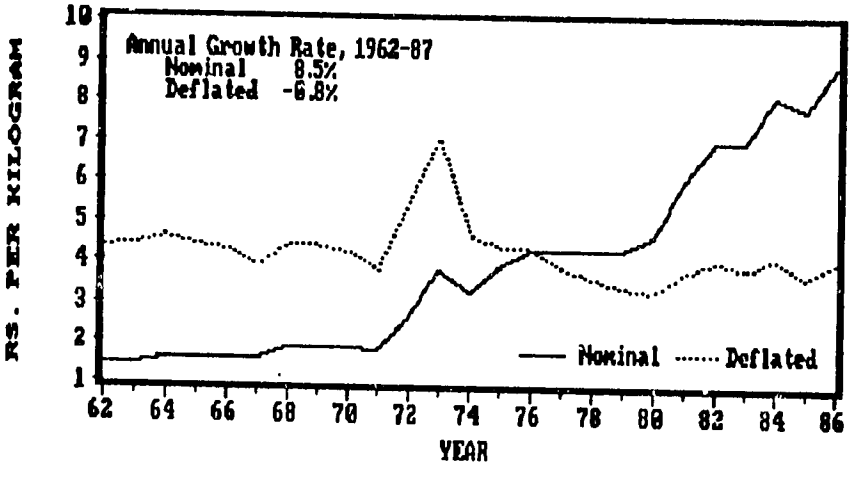


TABLE 5.3 RETAIL SUGAR PRICES, PAKISTAN, 1962-86

FISCAL YEAR	NOMINAL	DEFLATED [2]
	--------Rs. per kilogram--------	
1962	1.47	4.35
1963	1.48	4.40
1964	1.61	4.59
1965	1.61	4.38
1966	1.61	4.28
1967	1.59	3.89
1968	1.86	4.39
1969	1.88	4.37
1970	1.88	4.20
1971	1.80	3.80
1972	2.68	5.41
1973	3.81	7.01
1974	3.28 [1]	4.64
1975	3.89 [1]	4.34
1976	4.29 [1]	4.29
1977	4.30 [1]	3.85
1978	4.30 [1]	3.57
1979	4.30 [1]	3.35
1980	4.61 [1]	3.24
1981	6.00 [1]	3.75
1982	7.00 [1]	3.98
1983	7.00 [1]	3.81
1984	8.12	4.08
1985	7.82	3.66
1986	8.92	3.98

[1] Ration shop price
[2] Deflated by the Consumer Price Index (1976=100)
Source: Federal Bureau of Statistics

FIGURE 5.4 NOMINAL AND DEFLATED WHOLESALE GUR PRICES, 1962-86

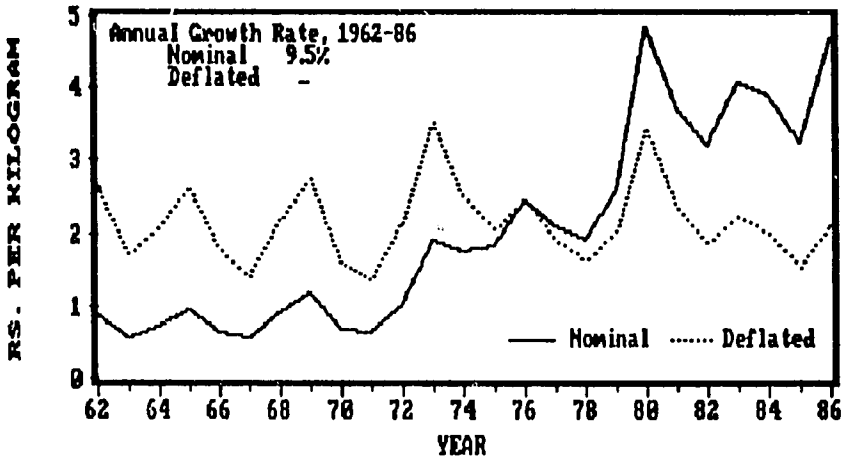


TABLE 5.4 WHOLESALE GUR PRICES, PAKISTAN, 1962-86

FISCAL YEAR	NOMINAL	DEFLATED [1]
	--------Rs. per kilogram--------	
1962	0.88	2.60
1963	0.57	1.69
1964	0.72	2.05
1965	0.96	2.61
1966	0.66	1.76
1967	0.56	1.37
1968	0.91	2.15
1969	1.18	2.73
1970	0.69	1.55
1971	0.64	1.34
1972	1.05	2.11
1973	1.91	3.51
1974	1.74	2.47
1975	1.81	2.03
1976	2.43	2.43
1977	2.10	1.88
1978	1.92	1.59
1979	2.58	2.01
1980	4.86	3.42
1981	3.71	2.32
1982	3.22	1.83
1983	4.07	2.21
1984	3.89	1.96
1985	3.26	1.52
1986	4.70	2.10

[1] Deflated by the Consumer Price Index (1976=100)

Source : Federal Bureau of Statistics

5.1.5 Seasonality of Refined Sugar and Gur Prices

Before the de-rationing of refined sugar in the early 1980s, official retail and wholesale sugar prices remained constant during the entire year as they were fixed by the government. Intra year variations did occur in "black market" sugar prices but information on these is not available. Even after de-rationing, when the sale of sugar was allowed in the open market, monthly refined sugar prices have remained largely flat with little seasonal variation. Figure 5.5 shows the seasonal index of open market sugar prices when the annual average equals 100.

In contrast, gur prices show a definite seasonal pattern (see Figure 5.6). They fall from October to December and then rise gradually during the rest of the year. The annual low is about 84% of the highest gur prices recorded during the year.

The difference in the seasonal movement in gur and refined sugar prices reflects the fact that the former are uncontrolled while the latter are subject to considerable government interventions. Refined sugar imports, the maintenance of a large buffer stock, and the sale of sugar at fixed prices through "utility stores" are the means by which the government continues to influence sugar prices. These interventions prevent open market sugar prices from varying much during the year The movement in gur prices, on the other hand, is related to the sugarcane production cycle with prices falling during and immediately after the harvesting period, and then rising slowly over the course of the year.

FIGURE 5.5 MONTHLY RETAIL REFINED SUGAR PRICES, LAHORE, 1981-87

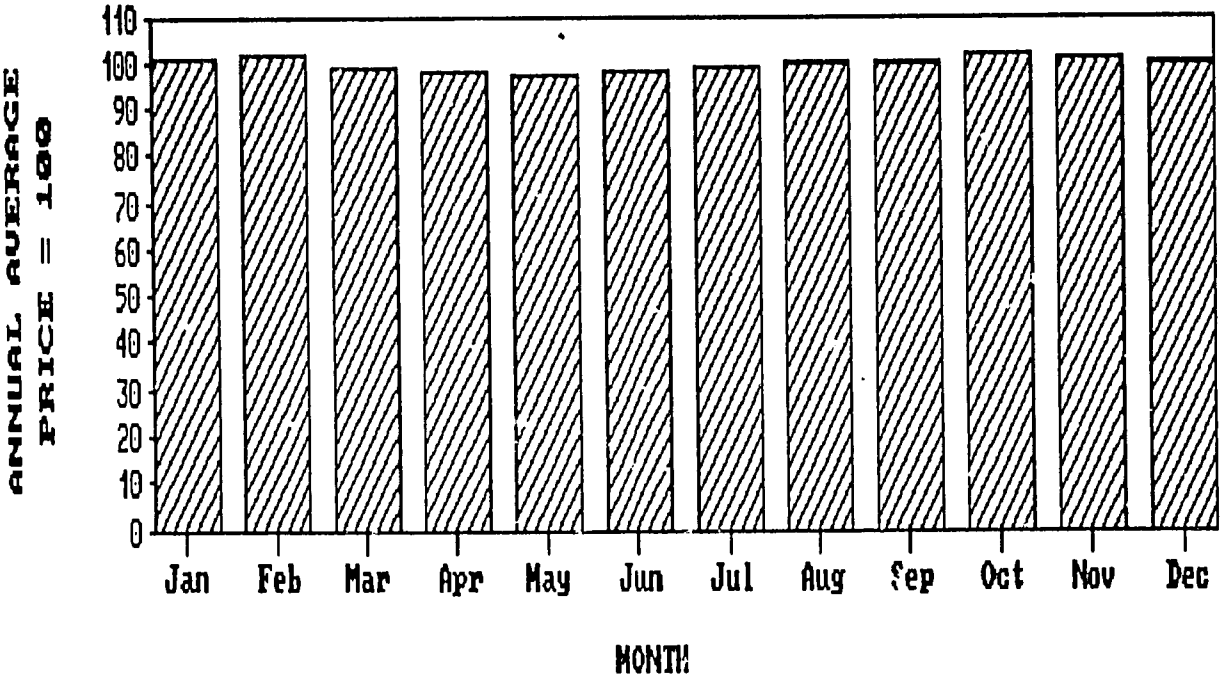
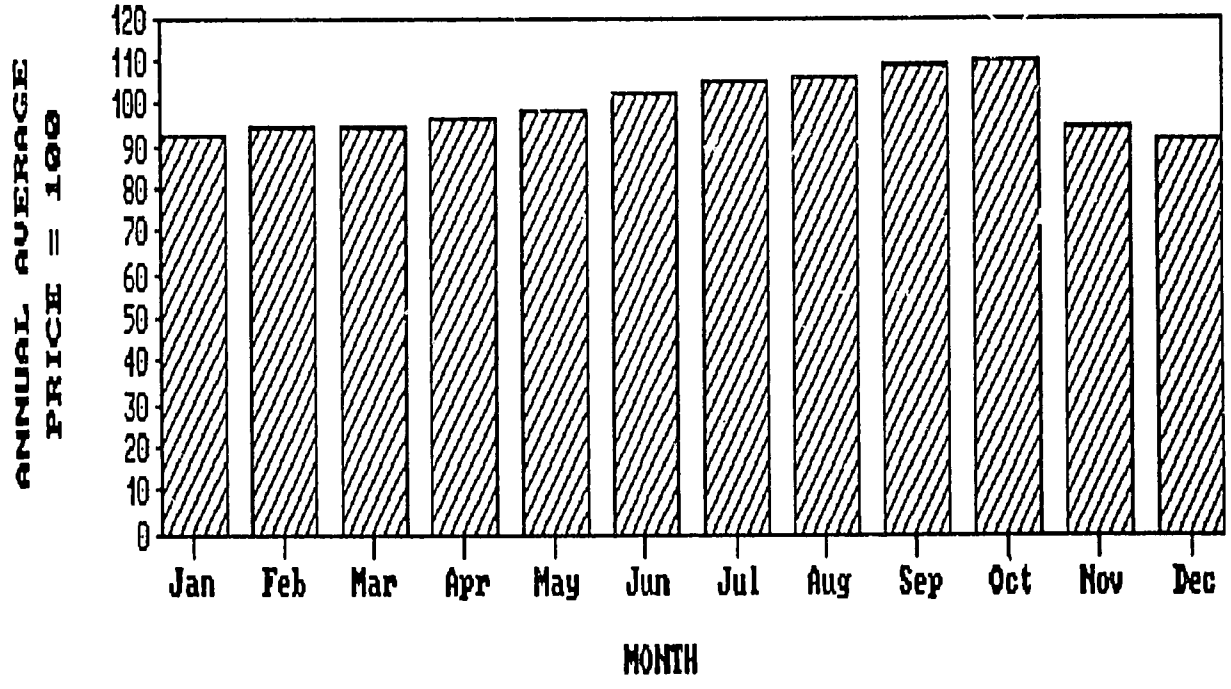


FIGURE 5.6 MONTHLY RETAIL GUR PRICES, PESHAWAR, 1981-87



5.1.6 Total Sweetener Consumption

The total consumption of sweeteners in Pakistan consists of the consumption of refined sugar, gur, shakkar, desi sugar, and small amounts of liquid sugar and fructose. This section focuses on trends in total sweetener consumption over the past 25 years. Because of their relative unimportance, and the fact that they are consumed mainly by industry, liquid sugar and fructose are excluded from this analysis. Also, since time series data on the individual consumption of gur, shakkar and desi sugar are not available or complete (see section 5.1.3), these are aggregated in terms of a 'gur equivalent.' It is further assumed that the 'gur equivalent' production in any year equals consumption.

Figure 5.7 and its associated table show trends in aggregate and per capita sweetener consumption in Pakistan over the period 1962-87. Total sweetener consumption has increased by about 3.3% per year since 1962, roughly at the same rate as population. As a result, total sweetener consumption in per capita terms has remained almost constant. Most of the increase in sweetener consumption has come from higher refined sugar consumption. The latter has increased at an average rate of 8.7% per year in aggregate terms and 5.5% per year in per capita terms. Increases in population, higher incomes, and falling real sugar prices appear to have been the main factors responsible for the increase in refined sugar consumption.

At the same time, higher refined sugar consumption has been accompanied by a decline in gur consumption. Although aggregate gur consumption does not reveal any significant trend over the period 1962-87, per capita gur consumption has declined at an annual average rate of about 2% over the same period. It appears, therefore, that refined sugar has increasingly substituted for gur in consumer diets. A glance at Table 5.5 shows that the real turning point seems to have occured around 1982, when per capita gur consumption started declining sharply after remaining more or less constant in the previous twenty years.

This phenomenon appears to be related with the derationing of sugar at first partially in 1981 and then completely in 1983, as well as generally higher sugarcane and sugar production in the early eighties. One explanation for the decline in per capita gur consumption since 1982 therefore is that, as greater quantities of sugar became available to consumers after derationing, it was increasingly substituted for gur. Another factor which may have encouraged the substitution of refined sugar for gur was the fall in sugar prices relative to those of gur over the period 1962-87.

The behavior of per capita gur and sugar consumption in recent years suggests that gur and refined sugar have become much closer substitutes than in the past.

FIGURE 5.7 PER CAPITA SWEETENER CONSUMPTION IN PAKISTAN, 1962-87

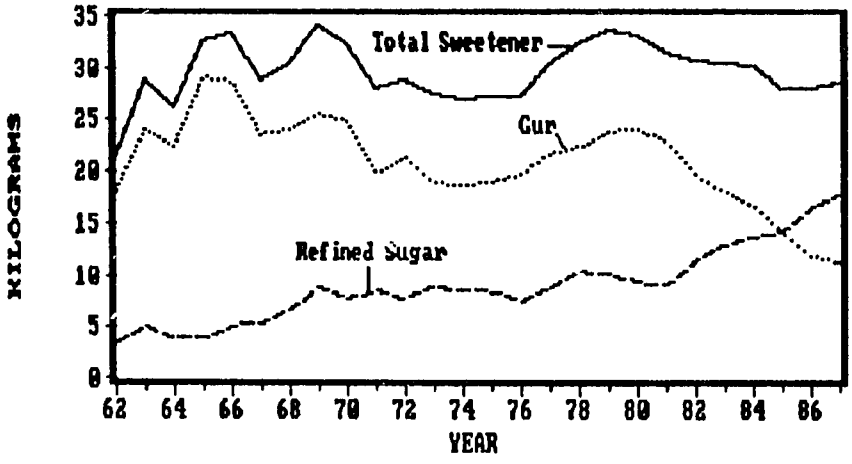


TABLE 5.5 TOTAL SWEETENER CONSUMPTION IN PAKISTAN, 1962-87

Fiscal Year	Aggregate Consumption			Per capita consumption.		
	Sugar	Gur	Total	Sugar	Gur	Total
	(000 MT)			(kg)		
1962	162	856	1018	3.4	18.0	21.4
1963	241	1168	1409	4.9	23.9	28.8
1964	189	1122	1311	3.8	22.3	26.1
1965	196	1496	1692	3.8	28.9	32.7
1966	267	1517	1784	5.0	28.5	33.5
1967	290	1285	1574	5.3	23.5	28.7
1968	365	1352	1717	6.5	24.0	30.5
1969	505	1473	1979	8.7	25.4	34.1
1970	455	1475	1930	7.6	24.7	32.3
1971	517	1216	1732	8.4	19.8	28.2
1972	485	1340	1825	7.7	21.2	28.8
1973	577	1241	1819	8.8	18.8	27.6
1974	569	1257	1826	8.4	18.5	26.9
1975	578	1322	1900	8.3	18.9	27.1
1976	537	1419	1957	7.4	19.7	27.1
1977	652	1613	2264	8.8	21.7	30.5
1978	780	1704	2485	10.2	22.2	32.4
1979	792	1874	2666	10.0	23.7	33.8
1980	744	1945	2689	9.1	23.9	33.0
1981	740	1905	2645	8.8	22.7	31.6
1982	976	1685	2661	11.3	19.5	30.8
1983	1137	1580	2717	12.8	17.7	30.5
1984	1244	1519	2763	13.5	16.5	30.1
1985	1326	1321	2646	14.0	13.9	27.9
1986	1594	1134	2728	16.3	11.6	27.9
1987	1763	1115	2878	17.5	11.1	28.6

5.2 Major Factors Affecting Sweetener Supply and Demand

5.2.1 The Determinants of Sweetener Supply and Demand

Figure 5.8 shows the major factors affecting the sweetener supply and demand balance in Pakistan. The supply and production of both sugar and gur equivalents is based on the production of sugarcane. Sugarcane production, in turn, depends upon its own price, the prices of cotton and fertilizer, technology, and weather. Cotton prices influence sugarcane production because cotton competes with sugarcane for acreage. Fertilizer prices are related with sugarcane output because fertilizer is an important component of sugarcane production costs.

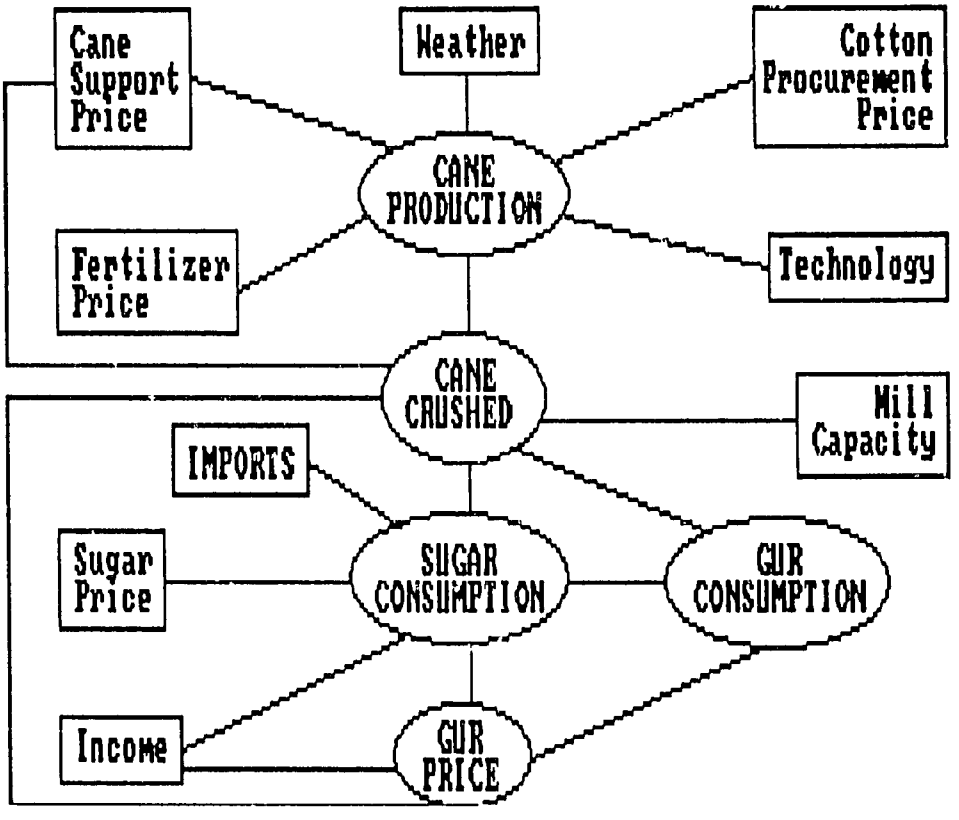
When sugarcane prices are high relative to those of cotton and fertilizer, cane production increases, all other things being equal. Conversely when sugarcane prices are low relative to those of cotton and fertilizer the acreage under sugarcane is reduced and production declines. Sugarcane production also depends upon the rate of yield-increasing technological developments and on weather. The latter is an important factor affecting cane production in any year since its cultivation depends heavily on adequate supplies of irrigation water. Shortages of water due to low rainfall have adversely affected cane output in many years.

The size of the sugarcane crop, relative sugarcane and gur prices, and the total installed crushing capacity of sugar mills determine the amount of sugarcane crushed by the mill sector and hence the quantity of refined sugar produced. The latter also depends upon the sucrose yield of the crop and mill recovery rates but these are for the most part given. Since gur is by far the largest component of total open pan sweetener production, it represents the principal alternative use of sugarcane.

When sugarcane prices are high relative to those of gur a larger proportion of the cane output is sold by growers to mills, resulting in higher refined sugar production, assuming all other factors are held constant. When sugarcane prices are low relative to gur prices less sugarcane is offered for sale to sugar mills and refined sugar production tends to fall. The absolute quantity of sugarcane crushed by the mill sector also depends upon the size of the sugarcane crop and the total mill crushing capacity in the country.

The quantity of sugarcane crushed by the mill sector simultaneously determines the quantity of sugarcane available for the production of gur and gur equivalents. This, together with gur recovery rates, determines gur production in any given year.

FIGURE 5.8 MAJOR ECONOMIC FACTORS AFFECTING SWEETENER SUPPLY AND DEMAND



Refined sugar consumption is related to its own price, the consumption of substitutes, and income. The income elasticity of refined sugar consumption is expected to be fairly high in Pakistan since per capita sugar consumption is still quite low. The gap between the domestic production and consumption of refined sugar is made up by imports.

Gur consumption is largely determined by the availability or production of gur, which, together with sugar consumption and income, influences gur prices. There is thus a fundamental difference in the way the refined sugar and gur markets are thought to behave. While sugar consumption depends upon its own price, in the case of gur, consumption determines price. This assumes that the gur market is essentially a residual one since gur production and consumption are determined by what happens in the refined sugar market. This view of the gur market seems to be supported by the declining relative importance of gur in the total sweetener market.

5.2.2 A Model of the Pakistan Sweetener Sector

Based on the discussion in the preceeding section, the following four-equation structural model of the Pakistan sweetener sector is specified :

(1) CCM = b11+b12(CQ)+b13(CPR)+b14(GURPR)+b15(NM)+b16(DUM)

(2) GURCC = (.85CQ-CCM)*GREC/POP

(3) SUGCC = b21+b22(SUGPR)+b23(GURCC)+b24(I)

(4) GURPR = b31+b32(GURCC)+b33(SUGCC)+b34(I)

Where the variables are defined as :

CCM = Quantity of cane crushed by sugar mills, tonnes (000)
CQ = Cane production, tonnes (000)
CPR = Nominal support price of sugarcane, Rs. per 40 kg
GURPR = Nominal wholesale price of gur, Rs. per 40 kg
NM = Number of sugar mills
DUM = Dummy variable,1in 1985 and 1986, 0 otherwise
GURCC = Gur consumption per capita, kgs
GREC = Gur recovery rate or (.1/.085)*actual sugar recovery rate, where .1 and .085 are the average gur and refined sugar recovery rates respectively
POP = Population, millions
SUGCC = Sugar consumption per capita, kgs
I = Gross National Product per capita at constant factor cost of 1959-60, Rs. Million,

and the b's are parameters in the respective equations.

Sugarcane production is based on the following relationship developed by Mubarik Ali which is discussed in detail in Section 2.2.2:

$$CQ = 4751*COTP^{-.201}*CPR^{.439}*NITP^{-.238}*CQ_{t-1}^{.242}*1.029^{T}$$

where

COTP = Price of seed cotton (phutti), Rs. per 40 kgs
NITP = The price of nitrogen in urea, Rs. per 50 kgs of nitrogen
CQ_{t-1} = Sugarcane production in the previous year, tonnes (000)
T = Time trend variable for technology improvement beginning with 30 in 1985/86

Equation (1) is the equation for the quantity of sugarcane crushed by the mill sector and hence indirectly for refined sugar production. One would expect the quantity of sugarcane crushed for sugar to be positively associated with sugarcane production, the price of sugarcane, and the total number of sugar mills operating, and negatively associated with the price of gur, the major alternative use of sugarcane. A dummy variable is included to capture the effects of a shift in cane production to the Sind in recent years.

The second equation is an identity which states that per capita gur consumption is equal to per capita gur production. Total gur production is calculated by subtracting the cane crushed by the mill sector from the total cane available for crushing and then multiplying by the gur recovery rate. The assumption that all the gur produced is consumed during the same year is admittedly an oversimplification, but unavoidable given the absence of any information on gur carryover stocks. The gur recovery rate used to estimate total gur production is derived by multiplying the ratio of "average" gur and sugar extraction rates by the actual sugar recovery rate.

Equation (3) is a fairly conventional consumption function where per capita sugar consumption is related to its own price, the consumption of substitutes (gur in this case), and income. The only departure from usual practice is the use of gur consumption rather than gur price to account for the effect of the existence of substitutes on sugar consumption. Purists are likely to contend that it is not possible to estimate the consumption of refined sugar using econometric methods because of the existence of rationing and hence "suppressed demand" throughout much of the period under review. However, despite the validity of these objections, it was felt that to model the demand for sugar would still be a worthwhile exercise since it would serve to illustrate the relationships involved. The preliminary results also seemed encouraging.

The last equation relates the price of gur with the per capita consumption of gur and sugar, and income. One would expect the price of gur to be negatively associated with per capita gur consumption because the latter reflects the quantity of gur that is put on the market. Low gur prices are likely to result in years when gur production and hence consumption are high. On the other hand when gur production is low, gur prices are likely to be high because of the reduced availability of gur in the market. The price of gur is also thought to be negatively related to per capita refined sugar consumption. This is because sugar and gur are substitutes with sugar consumption largely determining the demand for, and consumption of, gur. When sugar consumption is high, the demand for gur is reduced, which puts downward pressure on gur prices. Conversely, when sugar consumption is low the demand for gur increases which generates upward pressure on the

price of gur. Income reflects consumer purchasing power and is expected to be positively associated with gur prices.

The complete model thus specified has four endogenous variables - the quantity of cane crushed by sugar mills, per capita gur consumption, per capita sugar consumption, and the price of gur - all of which are determined simultaneously. The price of refined sugar is an exogenous variable since it has been determined or fixed by the GOP over much of the period under review. This means that there is only one-way causation between sugar consumption and prices i.e price determines the quantity consumed but not vice versa. Because the model is simultaneous, Ordinary Least Square estimation was not possible and the equations were estimated using the Two Stage Least Squares procedure based on data from 1962-86. The results are presented below with t-values indicated in parentheses :

$$\begin{aligned}(1)\ CCM &= -5551.94 + \underset{(2.86)}{0.2950}(CQ) + \underset{(2.30)}{934.005}(CPR) - \underset{(-2.40)}{42.2460}(GURPR) \\ &\quad + \underset{(2.13)}{136.0876}(NM) + \underset{(2.82)}{2482.46}(DUM) \\ &\quad R\text{-squared} = .95 \qquad D.W. = 2.07\end{aligned}$$

$$\begin{aligned}(3)\ SUGCC &= -1.5642 - \underset{(-1.94)}{0.8430}(SUGPR) - \underset{(-2.68)}{0.3153}(GURCC) + \underset{(5.10)}{0.0343}(I) \\ &\quad R\text{-squared} = .91 \qquad D.W. = 2.13\end{aligned}$$

$$\begin{aligned}(4)\ GURPR &= -127.2055 - \underset{(-2.09)}{5.7001}(GURCC) - \underset{(-2.86)}{25.6501}(SUGCC) + \underset{(4.49)}{0.940}(I) \\ &\quad R\text{-squared} = .78 \qquad D.W. = 2.36\end{aligned}$$

All the coefficients, except one, are significant at the 95% probability level, have the right sign, and are plausible. The exception, for sugar price is significant at the 90% level. The Durbin-Watson statistics do not indicate the presence of serious autocorrelation. The sugar consumption equation indicates a price elasticity of refined sugar consumption of -0.4 and income elasticity of 0.8 in nominal terms. The estimate of own-price elasticity is consistent with that reported by Ahmad and Ludlow (1987) who used a linear expenditure system approach based on household data. Previous estimates of the income elasticity of demand for refined sugar range from 0.6 to 2.0. While the present estimate falls at the low end of this range, it should be kept in mind that it relates to nominal and not deflated income. Overall, the model simulation results fit the historical data reasonably well (see Appendix C).

5.2.3 Sugar Supply and Demand Under Alternative Scenarios

In this section, demand and supply projections for refined sugar are made under alternative scenarios using the sweetener sector model developed above. The projections extend over the next two five-year planning periods. It should be stated at the outset that these projections are made for illustrative purposes only, to show the relationship between different factors affecting the supply and demand of sugar. No claim is made for their accuracy and for planning or forecasting purposes a simpler model may, in fact, yield better results.

Figures 5.9, 5.10 and 5.11 show the production and demand for refined sugar over the period 1988-98 under three different scenarios. The scenarios for sugarcane production are the same as in section 2.2.2.

In the first scenario, it is assumed that recent trends in prices, incomes and other parameters continue. Sugarcane and cotton prices increase by 6.1% and 3% per year respectively, the average rate at which they have increased over the past ten years. The price of nitrogenous fertilizers grows by 7.5% per annum relecting rising domestic production and import costs. It is assumed that per capita GNP, used as a proxy for personal income, grows at its trend rate of 3.5% annually in real terms, while population grows by 3% per annum. Sugar prices increase by 5.5% per year, roughly the rate at which they have increased since sugar was de-rationed in 1984. Assumptions regarding the establishment and phasing of new sugar mills are based upon the capacity planned and sanctioned by the GOP. Finally, the sugar recovery rate is assumed to remain constant at 8.9%, its average over the past ten years.

Under this scenario, the model predicts that the demand for refined sugar grows by 6.3% per annum to about 2.4 million metric tons in 1993 and 3.2 million metric tons in 1998. The increase in demand is due to the growth in population as well as higher per capita incomes. In per capita terms the demand for refined sugar is projected to increase to about 20 kilograms in 1993 and 23 kilograms in 1998. On the supply side, the model projects that domestic sugar production increases by 4.2% annually to about 1.6 million metric tons in 1993 and 1.9 million tons in 1998. Higher sugarcane production and the expansion of sugarcane crushing capcity in the mill sector contribute to the increase in refined sugar production. Since sugar production grows at a slower rate than demand, the gap between the two widens steadily to about 1.3 million metric tons by 1998. This gap will have to met by imports, otherwise domestic refined sugar prices can be expected to rise further.

FIGURE 5.9 SUGAR SUPPLY AND DEMAND PROJECTIONS, 1988-98 - SCENARIO I

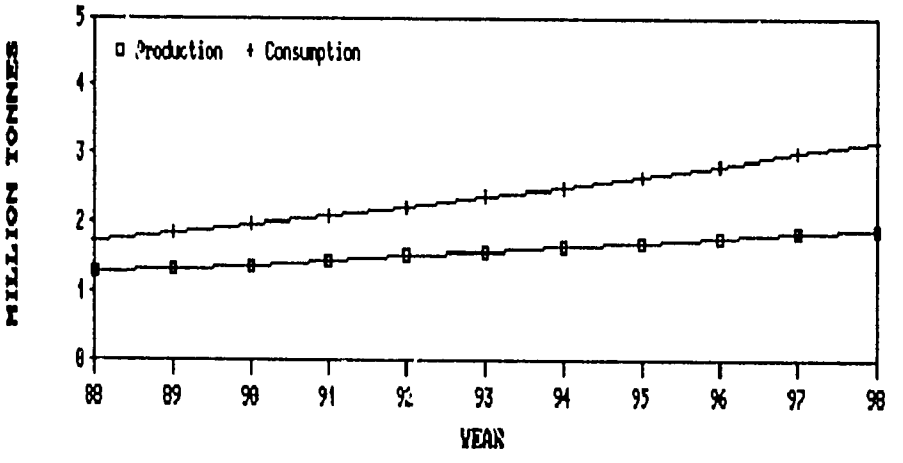


FIGURE 5.10 SUGAR SUPPLY AND DEMAND PROJECTIONS, 1988-98 - SCENARIO II

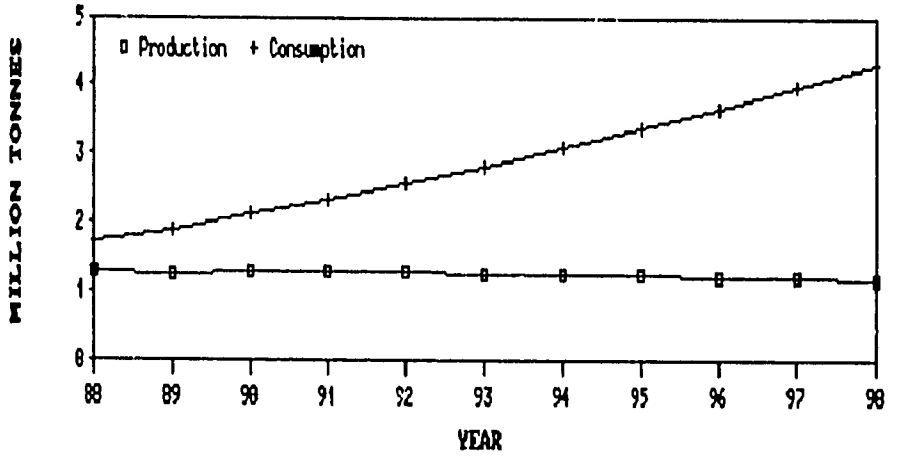
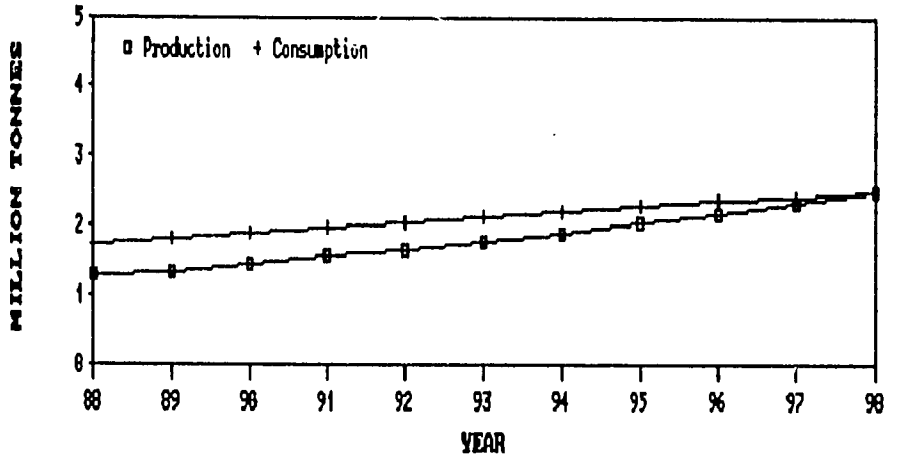


FIGURE 5.11 SUGAR SUPPLY AND DEMAND PROJECTIONS, 1988-98 - SCENARIO III



The scenario outlined above assumes that the trend rate of growth in sugarcane production representing yield-increasing technology advances continues. If the trend rate embodying technological improvements is assumed to be zero, sugarcane production stagnates and domestic sugar production grows more slowly, resulting in a larger gap between production and demand.

The level of sugar production indicated in the projections under Scenario I is higher than the existing and planned production capacity of the sugar industry, estimated at between 1.5-1.8 million metric tons. Therefore, in order to achieve these production levels, more capacity will have to be installed than is currently planned. As additional capacity is created this will, in turn, influence the quantity of cane crushed by the mill sector, and hence sugar production.

Sugar production is also likely to be higher than projected by the model as sugarcane production continues to move to the Sind. This is because relative cane and gur prices do not play a significant role in determining the quantity of cane crushed by mills in that province since gur making is not a viable alternative for the large commercial Sind cane growers. Increases in cane production in Sind should therefore result in a proportional increase in the quantity of cane crushed for sugar, as little or no "leakages" occur to the cottage sector.

Under the second scenario, sugarcane and sugar prices are held constant at 1987 levels, while cotton and fertiliser prices increase by 3% and 7.5% per year respectively. Per capita GNP increases by 3.5% annually. All other parameters are assumed to be the same as in the first scenario. Because sugar prices are held constant, demand grows rapidly, by nearly 10% per annum to 2.8 million metric tons in 1993 and over 4 million metric tons by the end of the decade. Production, on the other hand, declines by about 1% per year to 1.2 million metric tons in 1993 and 1.1 million metric tons by 1998.

The decline in sugar production is due to the decline in cane production which is only partially offset by the expansion in mill capacity. Under this scenario the gap between supply and demand, which has to be met by imports, increases to 1.5 million metric tons in 1993 and over 3 million metric tons by 1998. While this is an extreme case, it serves to illustrate what would happen if the GOP attempts to hold sugar and sugarcane prices constant. It is not surprising therefore that price controls on refined sugar have been accompanied by rationing in the past. The growth in the demand for sugar is fairly sensitive to assumptions regarding income growth. If the latter is lower, say by 2% per year, consumption increases by only 7.4% annually.

In the third scenario all other assumptions are the same but sugarcane and sugar prices increase by 10% and 8.5% per annum respectively. Under this scenario, demand grows by 3.7% per year to 2 million metric tons at the end of the next plan period, and 2.5 million metric tons by 1998. The increase in demand due to population growth and rising incomes is checked by higher sugar prices. At the same time, sugar production grows by 7% annually, due to both higher sugarcane production and a greater proportion of cane output being crushed by the mill sector. The latter, in turn, is due to cane prices rising faster than gur prices, which makes selling cane to mills more attractive to growers. Domestic sugar production under this scenario increases to about 1.8 million metric tons by 1993, and 2.5 million metric tons by 1998. This results in a modest surplus over domestic consumption by 1998. Again, considerably larger mill capacity will need to be created than planned if these levels of production are to be achieved.

Although the exact magnitude of the response may be debatable, the scenarios outlined above indicate the direction of change as key factors vary. The most important variables appear to be sugarcane and sugar prices. Cane prices influence cane production and, together with gur prices, the quantity of cane crushed for sugar. The price of refined sugar together with per capita income and population growth determines the rate of growth in demand. Though exogenously set, cane and sugar prices are inextricably linked and cannot move too far out of line with each other. This is because sugarcane is a major component of sugar production cost. If cane prices increase considerably relative to sugar prices, processing margins are eroded and sugar production becomes unprofitable. On the other hand if sugar prices increase greatly relative to cane prices, economic, political and social pressures are created for the cane price to increase.

In summary, the model developed indicates that if past trends with respect to prices, incomes, and population growth continue, the demand for refined sugar will continue to exceed domestic production and imports will rise steadily. On the other hand, if cane and sugar prices are held constant, even bigger deficits will develop, neccessitating extremely large imports to match supply with demand. Finally, if the GOP wants to achieve self-sufficiency in sugar production then both sugarcane as well as sugar prices will have to rise significantly over the next ten years.

These conclusions are a matter of some concern because sugarcane prices are already fairly high compared to other sugarcane producing regions of the world. At the same time sugarcane yields are low, resulting in high sugar production costs. Encouraging greater sugarcane production by increasing cane prices is likely to lead to higher sugar prices for consumers. But, perhaps more significantly, increased sugar production is likely to come at

the expense of other crops such as cotton and is therefore likely to have a high opportunity cost.

5.3 Foreign Exchange Implications Of Alternative Policies

5.3.1 Sugar Production Vs. Other Crops

A major GOP goal associated with domestic sugar production is foreign exchange savings and an improved balance of payments position. However, since sugarcane competes with cotton for acreage, encouraging the production of either inevitably involves trade-offs. It is useful, therefore, to quantify the benefits of each crop in terms of its contribution towards foreign exchange savings and/or earnings. Domestic Resource Costs (DRCs) are often used as a measure of the comparative advantage in producing different crops. A study has been commissioned under the Economic Analysis Network Project to estimate the DRCs of important crops in Pakistan and these estimates will be available on completion of the study.

Table 5.6 presents information on the direct gross foreign exchange savings and/or earnings per cropped hectare associated with sugarcane, cotton and wheat. At current prices, a hectare of sugarcane generates approximately US$873 in foreign exchange savings and/or earnings compared with US$652 from a hectare of cotton and US$332 from a hectare under wheat. However, since sugarcane is an annual crop a direct comparison with cotton, which occupies the land for only 6-7 months, is inappropriate. A more appropriate comparison is with a cotton-wheat rotation adjusted for cropping intensity and yields. (Cotton plus Wheat B, in Table 5.6). The advantage of sugarcane in terms of foreign exchange savings and/or earnings narrows further when the wheat-cotton rotation is considered as the alternative. As cotton yields increase further, the direct gross foreign exchange earnings and/or savings from a hectare of cotton may eventually exceed those from sugarcane.

It should be emphasized that the estimates presented here relate to foreign exchange savings/earnings accruing from the value of production only. They do not take into account either the foreign exchange spent on, nor the value of domestic resources used in, producing the stated output. As such, these figures are not a measure of the comparative advantage in producing different crops. Nevertheless, they indicate that while import substitution in sugar may save foreign exchange, the savings may not be much in net terms if the increase in sugar production is at the expense of cotton and wheat.

TABLE 5.6 DIRECT GROSS FOREIGN EXCHANGE SAVINGS/EARNINGS PER HECTARE OF SUGARCANE, COTTON AND WHEAT

	Yield/hectare [1]	Production	Value	
			Price/tonne [2]	Total
	(metric tons)		(US $)	
SUGARCANE	36.9			872.63
Sugar @ 8.5%		3.14	250	784.13
Molasses @ 4.5%		1.66	53.3	88.50
COTTON	1.49			651.92
Lint @ 33%		0.49	1253	613.97
Cottonseed oil @ 11% of 66%		0.11	345	37.95
WHEAT				
A (unadjusted)	1.74	1.74	190.9	332.17
B (adjusted)	1.40 [3]	0.49 [4]	190.9	93.54

[1] Average yields over the last three years (1985-87) except for Wheat "A" which is the average of the years 1985 and 1986.

[2] The prices for molasses, lint, cottonseed oil and wheat are average CIF or FOB Karachi prices for the period July-October 1987 reported by the Federal Bureau of Statistics. For sugar, the price used is that reported to have have been contracted by the Trading Corporation of Pakistan in February 1988.

[3] Wheat yields adjusted for late planting due to cotton harvesting.

[4] Wheat production per hectare is adjusted downward to reflect a cropping intensity of 135% typically achieved in cotton-wheat rotation zones.

5.3.2 Sugar Production Vs. Other Sweeteners

In other countries, particularly the U.S., sugar's share of the sweetener market has been declining because of its substitution by High Fructose Corn Syrup in the soft drinks, bakery, and confectionary industries. Fructose production in Pakistan is still in its infancy. Corn is processed at two plants into starch, gluten meal, glucose, and corn syrup. Another plant produces fructose from broken rice, though it appears to operate intermittently. The glucose and corn syrup are used in the manufacture of candies, jams and jellies. According to industry spokesmen, the sales of candies have been strong and additional corn syrup will likely be produced and used for this purpose during the next few years.

The potential for liquid sweeteners, corn or rice based, as substitutes for sugar faces both positive and negative influences in Pakistan. The demand-dampening factors are that presently HFCS is available only in liquid form and must be stored at constant temperature. Its use is confined to industry. However, this is a sector benefitting from increased consumption of soft drinks and bakery goods, and appears to be a market for the high protein by-product corn gluten, used for dairy and poultry feed. The relative profitability of producing maize or rice must approach that for crops for sweetener manufacturing. Desirable characteristics of the foodgrain crops, as a raw material, are that they can be stored for a year or more before processing. They can also be transported easily. These characteristics are in stark contrast to sugarcane and sugarbeets which are highly perishable. They are also too bulky and heavy to be transported long distances. Thus, non-sugar sweetener processing plants can be operated year-round while sugar processing is highly seasonal. This factor alone contributes to reduced efficiency in utilizing processing capacity.

As incomes increase, the consumption of processed foods and beverages will rise. This will create opportunities for corn-based liquid sweeteners to replace sugar in many present industrial uses. The growth of corn-based sweetener production will have important foreign exchange implications if it results in additional acreage being brought under corn. This is because it will not only provide sweeteners for industrial use but also augment feed supplies in the form of corn gluten meal.

5.4 Alternative Sweetener Policies: Summary of Implications

The demand for sweeteners, and refined sugar in particular, is likely to grow substantially in Pakistan over the next decade. On the other hand, if past trends continue, sugar production will stagnate or grow slowly. This implies a steadily increasing deficit between supply and demand which will have to be met either through higher imports or sharp increases in the domestic price of sugar. In the context of a rising import bill and the build up of inflationery pressures, Pakistan will therefore have to make some hard decisions regarding future sweetener policies.

The goal of self-sufficiency in sugar production, often mentioned, seems difficult and is likely to be achieved only at a fairly high cost. Large increases in the prices of both sugarcane and sugar will be required over the next ten years in order to equate supply and demand. Since domestic sugar production costs are already well above world market prices, encouraging production by raising prices will entail substantial costs to the economy.

Even in terms of foreign exchange savings, self-sufficiency in sugar production seems to be a questionable goal. This is because increases in cane production are likely to be achieved at the expense of cotton. Any gain in foreign exchange savings by import substitution, therefore, will tend to be offset by the loss in earnings from cotton exports.

In addition, the contribution of increased domestic sugar production to government revenues is also lower than in the case of importing sugar. The current import duty on sugar is Rs.4 per kilogram compared with an excise duty of Rs.2.15 per kilogram on local production. Total government revenues from domestic production are somewhat higher since sugar mills also pay corporate income taxes but this does not change the conclusion significantly.

Given the above, it is hardly surprising that the GOP has not pursued the goal of self-sufficiency in sugar production too vigorously in recent years. It has, instead, increasingly relied upon imports to meet the gap between production and consumption, as well as prevent domestic sugar prices from rising too rapidly. As long as a "cushion" of low international prices is available, this remains a prudent policy. At the same time, efforts need to be made to reduce domestic sugar production costs by improving productivity and yields.

6. THE REGULATORY FRAMEWORK

6.1 Introduction

The purpose of this chapter is to provide an overview of the regulatory framework in which the Pakistan sugar industry operates. This overview includes a description of both past and current regulations affecting the sugar industry as well as the process by which sugar policy is made.

The chapter is organized as follows. Section 6.2 contains a description of the main regulatory, pricing, import, taxation and other policies which have shaped the development and current situation of the sugar industry. The policymaking process is described in Section 6.3. This includes a summary of both past and present sugar policy and a description of the main institutions involved in its formulation. Section 6.4 presents conclusions and suggests measures to strengthen the sugar policymaking system.

6.2 Regulation and Taxation of the Sugar Industry

6.2.1 The Sugar Factories Control Act

The Sugar Factories Control Act (1950) and the accompanying Sugar Factories Control Rules regulate the marketing of cane by growers to mills. In their essentials these follow and build upon the Sugarcane Act (1934) which pre-dates the independence of the country.

Under the provisions of the Act, mills were allocated zones or areas from where they were required to procure a specified proportion of their cane requirements. This proportion varied between provinces. It was 80% in the Punjab, 65% in the NWFP, and 100% in the Sind. In turn, growers in mill zones were obligated to supply sugar mills a similar proportion of their cane production. Utilization of cane for other purposes was restricted by regulations such as Section 144 which prohibited growers from making gur beyond a certain minimum to meet their domestic needs.

Zones for each mill were fixed annually by Provincial Cane Commissioners based upon their estimate of cane requirements. Mills were required to keep a growers register and make an estimate of the cane production of each grower. Before the beginning of each crushing season mills had to contract for all cane offered by growers and issue 'indents' or requisition slips. These 'indents' authorized growers to supply a specified quantity of cane to the

mill at a particular place on a given date. Since every grower wanted his cane to be lifted first, mills were required to ensure that the 'indents' were issued equitably so that purchases from growers were spread over the length of the crushing period. The involvement of middlemen in the marketing of cane to the sugar mills was specifically prohibited by the Sugar Factories Control Act.

Provincial Cane Commissioners were responsible for implementation of the provisions of the Act and supervisory committees comprising growers, millers and government representatives were constituted in each mill zone to ensure that no irregularities or malpractices took place. The Act provided for penalties in case of violation of contracts or infringement of other specified procurement procedures.

In 1987, the government removed all restrictions on growers with respect to both gur making and the supply of cane to sugar mills. Growers are now free to supply cane to any mill they choose or to make gur out of it. The provincial governments are currently in the process of making the necessary amendments to the Sugar Factories Control Act though it is unclear at this stage what practical shape the new system will eventually take.

6.2.2 Minimum Support Prices of Cane and Beet

The minimum prices to be paid by the mills for cane and beet are fixed each year by the government. Cane prices vary by province, ostensibly reflecting differences in quality, and are highest in the Sind followed by the Punjab and the NWFP. In each province there are two prices for cane: factory gate, and outstation. Outstation prices are lower than those at the factory gate because, theoretically at least, they take into account transportation costs incurred by mills in moving the cane from various purchasing centers to the factory.

The support prices of cane and beet during the period 1970-87 are presented in Table 6.1. As the table shows, the support price of cane has increased by about 300% in nominal terms since 1970 while beet prices have gone up by nearly 180% since 1973. The increase in the support prices of cane and beet have not, however, been gradual. Instead, the pattern has been one of sharp, sudden increases followed by long periods of static prices. For example, after an increase of nearly 30% in 1981, cane prices remained unchanged for six years until they were increased again by about 22% in 1987. Support prices of cane in Pakistan have been relatively high in relation to its recoverable sugar content. In 1986, the price of sugar still in the cane was 80% of the C&F cost of imported sugar.

TABLE 6.1 MINIMUM SUPPORT PRICES OF SUGARCANE AND SUGARBEET, 1970-1987

(Rs/40 Kg)

FISCAL YEAR	CANE - FACTORY GATE			CANE - OUT STATION			BEET
	PUNJAB	SIND	NWFP	PUNJAB	SIND	NWFP	NWFP
1970	2.95	3.11	2.41	2.70	2.84	2.14	N.A.
1971	2.95	3.11	2.41	2.70	2.84	2.14	N.A.
1972	2.70	2.84	2.41	2.41	2.57	2.14	N.A.
1973	4.55	4.72	4.29	4.29	4.45	4.02	5.37
1974	4.55	4.72	4.29	4.45	4.45	4.02	5.37
1975	5.63	5.79	5.37	5.37	5.45	5.09	6.70
1976	6.16	6.32	5.89	5.89	6.06	5.63	6.97
1977	6.16	6.32	5.89	6.06	6.06	5.63	6.97
1978	6.16	6.32	5.89	5.89	6.06	5.63	6.97
1979	6.16	6.32	5.89	5.89	6.06	5.89	6.97
1980	7.50	7.66	7.23	7.18	7.29	7.23	10.72
1981	9.65	9.81	9.38	8.84-9.16	9.43	-	10.72
1982	9.65	9.81	9.38	8.84-9.16	9.43	-	10.72
1983	9.65	9.81	9.38	8.84-9.16	9.43	-	10.72
1984	9.65	9.81	9.38	8.84-9.16	9.43	-	10.72
1985	9.65	9.81	9.38	8.84-9.16	9.43	-	10.72
1986	9.65	9.81	9.38	8.84-9.16	9.43	-	10.72
1987	11.79	11.95	11.52	8.84-9.16	9.43	-	15.00

Source:- Agricultural Statistics of Pakistan

Payment for cane and beet is on the basis of weight. Since 1981, however, mills have also been required to pay a quality premium to cane and beet growers based upon the season's average sugar recovery rate. The quality premium is currently Rs. 0.15 per 40 kilograms of cane for each 0.1% excess recovery above 8.7% in the NWFP, 8.5% in the Punjab and 9.3% in the Sind. For beet the quality premium is Rs. 3.22 per 40 kilogram for every 0.1% excess recovery above 9%.

Mills in the NWFP have to pay a special quality premium of Rs 1.07 per 40 kilogram to cane growers. In fiscal year 1987, the government also provided a special subsidy of Rs 3.48 per 40 kilograms to cane growers in the NWFP in order to enable the sugar industry in the province to compete with gur processors for cane supplies.

6.2.3 Price and Distribution Controls on Refined Sugar

Since independence, the government has exercised varying degrees of control on the white sugar market. Depending upon its availability, government policy on marketing of white sugar has

alternated between complete control, partial control and free trade.

From 1972 to 1981, the ex-mill and retail prices of sugar were determined by the government which had a monopoly on its purchase and sale. The Provincial Food Departments were responsible for the distribution of sugar through government ration shops which lifted the product directly from mills for sale to the public. The ration shops catered mainly to the urban population and monthly rations in the mid 1970s were approximately 1 kilogram in the main towns.

In 1981, price and distribution controls were relaxed and mills were allowed to sell 10% of their production in the open market. As the supply situation improved, sugar was de-rationed by the government in 1983 and all price and distribution controls on white sugar were lifted. Mills can now sell to whomever they please and at whatever rate the market can bear. The government, however, continues to influence sugar prices by varying the level of import duties to encourage imports by the private sector as well as directly importing sugar for sale at fixed prices through the Utility Stores Corporation.

6.2.4 Import Duties and Restrictions

Until recently, only the government could import sugar. When required, imports were made by the Trading Corporation of Pakistan and either released to the ration shops for sale to consumers or stored in government godowns. In 1983, sugar was placed on the 'free list' of importable commodities and the private sector allowed to import it directly. At the same time, the government imposed a prohibitive import duty of Rs 6.50 per kilogram on refined sugar. The import duty on sugar was subsequently reduced to Rs 5 per kilogram in July 1985 and Rs 4 per kilogram in February 1986 as the government sought to encourage imports by the private sector in order to alleviate upward pressure on domestic sugar prices due to production shortfalls.

Private importers are currently required to register with the Chief Controller, Imports and Exports, who issues licences which enable them to apply to the State Bank of Pakistan for foreign exchange.

6.2.5 Excise and Other Taxes

Substantial revenues are derived by the government from an excise duty on sugar production. The manner in which this duty has been applied has varied over time. Originally a levy on actual production, it was changed in 1966 to one on the production capacity of each mill. The latter was determined by the Central Board of

Revenue on the basis of an average recovery rate for each province and a 160 day crushing period. In 1978 the duty was changed again to one on actual production.

As Table 6.2 shows, excise duties have averaged between 25%-30% of the retail price of sugar over the last decade.

TABLE 6.2 EXCISE DUTIES AND RETAIL SUGAR PRICES, 1970-86

FISCAL YEAR	EXCISE DUTY	RETAIL SUGAR PRICE [1]	EXCISE DUTY/ RETAIL PRICE
	---(Rupee per kilogram)---		(percent)
1970	0.28	1.88	15
1971	0.28	1.86	15
1972	0.28	2.68	10
1973	0.28	2.27	12
1974	0.82	3.17	26
1975	0.82	3.89	21
1976	1.35	4.29	31
1977	1.35	4.30	31
1978	1.35	4.30	31
1979	1.35	4.30	31
1980	1.35	4.61	29
1981	1.35	6.00	23
1982	2.15	7.00	31
1983	2.15	7.00	31
1984	2.15	8.12	26
1985	2.15	7.82	27
1986	2.15	8.92	24

[1] Prices from 1973-83 are controlled prices.

Source : Economic Survey, 1986-87, Ministry of Finance; Central Board of Revenue

The present excise duty is Rs 2.15 per kilogram of sugar though this is not necessarily the amount actually paid by mills per unit of production due to the existence of a number of exemptions. For example, to encourage higher sugar production and presumably discourage its under-reporting, the government has exempted all sugar produced in excess of the previous two years' average from the payment of excise duties. Also, in recognition of the higher initial operating costs of new mills, the latter are exempted from payment of 50% of the excise duty leviable on their production during the first two years of operation. Sugar

produced from beet is also exempt from payment of any excise duty in order to compensate millers for the higher production costs incurred on its processing and to provide support to an ailing sugar industry in the NWFP.

Although nominal, another levy on the sugar industry is the cane development cess. Each grower delivering cane to a sugar mill has to pay Rs. 0.07 per 40 kilograms of cane as development cess and a matching amount is contributed by the mill. After deduction of collection charges the cess goes into a Sugar Cane Development Fund for each mill zone. The cess is used for the purpose of maintaining and developing insfrastructure in the mill zone such as roads and bridges, plant protection services, or any other cane development activities approved by the government.

6.2.6 Consumer Subsidies

In order to keep consumer prices low, the government has provided budgetary subsidies on sugar in the past. These subsidies reached a peak in 1981 when large quantities of sugar had to be imported at a time of high international prices to meet domestic production shortfalls. However, as Table 6.3 shows, consumer subsidies on sugar have not been very large in relation to those on other products such as wheat and edible oil.

TABLE 6.3 EXPLICIT CONSUMER SUBSIDIES ON SUGAR, EDIBLE OILS AND WHEAT, 1974-86

FISCAL YEAR	SUGAR	EDIBLE OILS	WHEAT
	(Rupees million)		
1974	-	269	1917
1975	-	443	2119
1976	-	-	1543
1977	4	-	1107
1978	21	-	1634
1979	11	577	2513
1980	20	884	2353
1981	83	583	1050
1982	-	1	1303
1983	38	-	1122
1984	15	1485	1267
1985	10	2245	2883
1986 [1]	-	2477	2898

[1] Budget estimate
Source : Finance Division

In recent years, consumer subsidies on sugar have been nil, although an amount under this head continues to be reported in government statistics. The latter represents liabilities of past trading losses or is simply an accounting entry based upon the difference between the landed cost of imported sugar plus import duty and the price at which the government sells sugar. Revenues from the import duty on sugar more than offset the reported subsidies for sugar. In 1986 for example, the government probably derived substantial revenues from the import of sugar since import costs excluding import duties were only about half of the retail price at which sugar was sold by Fair Price Shops.

6.2.7 Controls on Investment

Until last year, sugar manufacturing was included in the list of Specified Industries for which Federal Government approval is required before any investment in new capacity. Investment sanctions were needed for setting up new sugar mills as well as expanding capacity in existing mills. In addition, sanctions were also required from the Provincial Governments who excercised locational control.

With the removal of the sugar industry from the list of Specified Industries in 1987, no Federal Government sanction is now necessary for investment in the industry. Controls on investment, however, continue to exist at the provincial level, and the fact that financing agencies are in the public sector means that effective investment sanctioning authority remains with the GOP.

6.3 Sugar Policy and Policymaking Structure

6.3.1 Past and Current Sugar Policy

The Government of Pakistan's sugar policy to date has been characterized by the following, often conflicting, objectives:

(a) to achieve self-sufficiency in sugar production;

(b) to ensure the availability of sugar to consumers at low prices; and

(c) to raise government revenues by taxing sugar production.

In order to achieve self-sufficiency in sugar production, the government has maintained high support prices for cane and provided protection to the domestic sugar industry by imposing tariffs and other controls on the import of sugar. At the same time, the government has exercised varying degrees of control on the marketing of white sugar including its rationing at fixed

prices through official retail outlets to keep the price of sugar low for urban consumers. The sugar industry has also been subject to high excise taxes on sugar production which, over time, have become an important source of government revenue. Although raising revenues through taxes on the sugar industry has never been an explicitly stated government objective, it has become an increasingly important one in the context of budgetary pressures and the need to mobilize domestic resources.

These policies have met with only partial success. Price and distribution controls were basically unsustainable over the long run due to the potentially large subsidies that would have been necessary in order to keep consumer prices low and also because they did not encourage more sugar production. Heavy taxes on white sugar production have restricted the ability of the mill sector to compete for available cane supplies and led to underutilization of capacity, particularly in low cane production years. Also, despite high support prices, cane production has stagnated in recent years (although 1987-88 was a better year) and yields have remained low. The result is that Pakistan today is a relatively high cost producer of sugar and large imports are still required periodically in order to meet the growing demand for sugar.

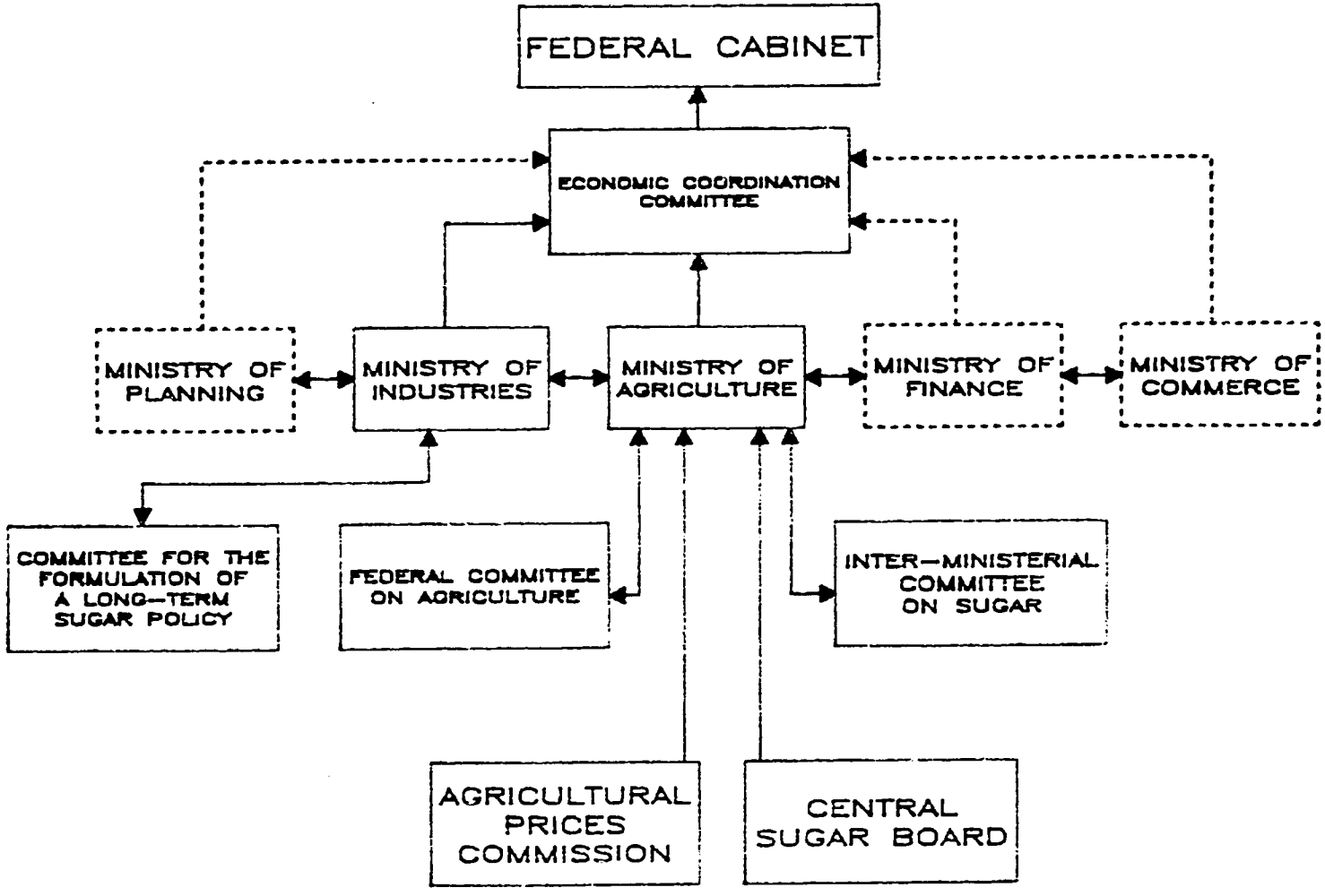
Achieving self sufficiency in sugar production remains an important GOP goal. At the same time, there seems to be an awareness of the costs involved in pursuing such a policy to its extreme. Recent policy documents emphasize the importance of increasing production by improving yields rather than expanding area and call for greater research and development efforts in the sugarcane sector.

6.3.2 Present Sugar Policymaking Structure

According to the constitution of Pakistan agriculture is a provincial subject. In practice, however, agricultural policies are largely initiated and determined by the federal government and its associated agencies.

Figure 6.1 illustrates the present organization of sugar policymaking in Pakistan. The core of the policymaking system consists of the Ministry of Food, Agriculture and Cooperatives, the Ministry of Industries, and the different agencies which feed into them. These agencies put forward various proposals regarding minimum support prices for sugarcane and beet, quality premiums, subsidies, taxes, investment sanctions, imports and import duties for consideration by the government. Ultimately, all proposals relating to sugar policy are referred to the Economic Coordinating Committee (ECC) of the Federal Cabinet. After consideration by the ECC these proposals are taken to the Federal Cabinet for final approval.

FIGURE 6.1 ORGANIZATION OF SUGAR POLICY MAKING



Some of the important ministries and other government bodies concerned with sugar policymaking are described below.

Agricultural Prices Commission : The Agricultural Prices Commission (APCOM) was established in 1981 to advise the government on pricing policies for different agricultural commodidites. Although affiliated with the Ministry of Food, Agriculture and Cooperatives, APCOM is an autonomous body headed by a Chairman appointed by the President. The Commission regularly conducts production cost surveys on the basis of which it recommends miminum support prices for major crops each year. Within APCOM, a Standing Committee for Sugarcane is responsible for recommending the minimum support prices for cane. This committee includes both growers' and millers' representatives. A criticism of APCOM is that it relies almost exclusively on a single crop, cost-of-production-approach to pricing policies which does not adequately take into account the effect of support price policies on other crops.

Central Sugar Board : The Central Sugar Board comprises government, industry and growers' representatives and advises the government on policies relating to the sugar industry. The Board meets once a year and the meeting is chaired by the Secretary of the Ministry of Food, Agriculture and Cooperatives. The list of members is shown in Appendix D. The Central Sugar Board is simply an advisory body with no permanent staff whose importance has declined somewhat over time.

Provincial Cane Control Boards : Under the Sugar Factories Control Act (1950), Cane Control Boards have been set up in each of the three sugar producing provinces. Each Board consists of a Cane Commissioner as Chairman, the Director of Industries, the Director of Agriculture and, from each factory zone, a mill representative and a growers representative nominated by the provincial government. In theory, the functions of the Boards are to advise the provincial governments on the price of cane and any other matter relating to the supply of cane to sugar mills. In practice, the Provincial Cane Boards are generally regarded as ineffective. This is illustrated by the fact that none of the Provincial Cane Commissioners serves on a full time basis.

Inter-Ministerial Committee on Sugar : An Inter-Ministerial Committee on Sugar was established by the ECC of the Cabinet in 1986 following a fall in sugar production and consequent upward pressure on retail prices. The functions of the Committee are to: (a) monitor sugar availability and price trends in the country; (b) prepare an annual sugar budget for the following year which takes into account expected availability and consumption; and (c)

recommend policies particularly relating to import duties and the level of imports which would enable the government to achieve its objectives of preventing consumption shortfalls and maintaining price stability. The Committee is chaired by the Special Assistant to the Prime Minister on Food and Agriculture and consists of the Federal Secretaries of the Ministries of Food, Agriculture and Cooperatives, Finance, Commerce, Industries, and the Statistics Division.

Federal Committee on Agriculture : The Federal Committee on Agriculture (FCA) was constituted in 1972 as a "high powered committee" with the objective of providing a mechanism to ensure coordination between different ministries and quick implementation of policy decisions relating to agriculture. This committee, which is chaired by the Federal Minister of Food, Agriculture and Cooperatives, has grown from 7 to 38 members and includes representatives from almost every ministry and government agency connected with agriculture. The FCA meets twice a year to review the position of major crops and the availability of key inputs. It also recommends annual production targets for all the major crops including sugarcane and suggests various measures to achieve these targets.

Ministry of Food, Agriculture and Cooperatives : Of all the government agencies and ministries involved in sugar policymaking, the Ministry of Food, Agriculture and Cooperatives (MINFA) appears to play a leading role. It is represented on all the key committees concerned with sugar policy, provides much of the information on the basis of which sugar policy is made, and serves as the principal channel by which policy recommendations of different advisory bodies are communicated to the Federal Cabinet. Each year, based on the recommendations of the APCOM and to a lesser extent the Central Sugar Board, MINFA prepares a summary for the consideration of the ECC. This summary includes proposals for the minimum support prices of cane and beet, quality premiums, tax exemptions, subsidies and other non-price measures for the next crop year. When approved by the Federal Cabinet this becomes the annual sugar policy for the country. The sugar policy is normally announced in September/October before the start of the crushing period and the planting of the next crop. However, for fiscal year 1987 the sugar policy was announced in December 1986, which was too late to affect the growers' planting decisions in that year. The MINFA also prepares an annual sugar budget for the Inter-Ministerial Committee on Sugar. The sugar budget contains information on the expected availability and consumption of sugar during the next year and serves as the basis for the recommendations relating to import policies made by that committee. Despite its pivotal role, the MINFA appears to be somewhat poorly equipped to handle its various reponsibilities

with respect to sugar policymaking. A major weakness appears to be the absence of any "in house" economic analysis capability.

Ministry of Industries : The Ministry of Industries is responsible for putting forward proposals relating to the expansion of the sugar manufacturing capacity in the country. Based upon its recommendations, the ECC sanctions additional capacity in the sugar industry which is allocated to different provinces. Individual projects are sanctioned by the provincial governments which are responsible for the selection of the location and sponsors subject to the guidelines provided by the federal government.

Committee for the Formulation of a Long-Term Sugar Policy : In 1982, the ECC set up a committee headed by the Secretary of the Planning Ministry with representatives from the Ministries of Industries, Finance and Food, Agriculture and Cooperatives to recommend a long term policy for the expansion of the sugar industry. The committee was subsequently enlarged to include representatives from development finance institutions and the private sector. The committee's specific terms of reference were to: (a) review the existing sugar manufacturing capacity and examine the scope for further expansion of the sugar industry; (b) study and recommend measures for making the industry more efficient and competitive in export markets; and (c) review existing sanctioning and location policies for the establishment of sugar mills and suggest measures to provide a more rational basis for sanctioning new units. The committee submitted its report in January 1987 which is currently being reviewed by the government. Among other recommendations, the committee apparently suggested the simplification of existing sanctioning procedures and the discontinuance of zoning.

Other Ministries : The Ministries of Finance, Planning, and Commerce also provide inputs to the sugar policymaking process. The Ministry of Finance is represented on most of the important committees concerned with sugar policy such as the FCA and the Inter-Ministerial Committee on Sugar. In addition, the Minister of Finance is the chairman of the Economic Coordinating Committee of the Cabinet, the highest economic policymaking body in the country. The Ministry of Planning proposes long-term production targets for all the major crops including sugarcane in connection with the formulation of the five year development plans. Once approved, these serve both as a statement of government intent as well as a guide to other agencies such as the FCA. Although recommendations on import policies related to sugar are often initiated by the Ministry of Food, Agriculture and Cooperatives and the Inter-Ministerial Committee on Sugar, these are incorporated in the annual import policy proposed by the Ministry of Commerce.

6.4 Conclusions and Recommendations

The Pakistan sugar industry has been highly regulated. Government interventions to date have taken the form of support prices for cane, regulations on its marketing to mills, price and distribution controls on white sugar, its rationing to consumers, tariff and non-tariff restrictions on sugar imports, controls on investment in processing capacity, and heavy taxes on sugar production. The main considerations underlying many of these regulations have been the often-conflicting, objectives of (a) achieving self-sufficiency in sugar production; (b) ensuring the availability of sugar to consumers at low prices; and (c) generating government revenues by taxing the sugar industry.

The GOP has been only partially successful in meeting these objectives. Recently, it has taken a number of steps towards deregulation of the industry. These include de-rationing of sugar and the removal of price and distribution controls on its marketing in 1983 and the discontinuance of zoning in 1987. The government continues to be committed to achieving autarky in sugar production though there is growing recognition that this should be achieved by improvements in productivity and not area expansion.

The policymaking structure in Pakistan is fairly complex and a number of agencies are currently involved in the formulation of sugar policy. The leading role in sugar policymaking, however, appears to be that of the Ministry of Food, Agriculture and Cooperatives and the various committees and institutions providing inputs to it. Although there seem to be no major problems with the formal organization of the sugar policymaking system, it suffers from a number of weaknesses. These include: (a) an excessive preoccupation with short-term considerations; (b) a lack of economic policy analysis capability in the relevant ministries; (c) a single-crop approach to pricing policies which does not adequately take into account the effect of support prices on other crops; and (d) ineffective industry and grower involvement in sugar policymaking.

In the context of the discussion above, the following recommendations are made to strengthen the present sugar policymaking system:

(a) The Sugar Board should be made more effective and provided with a small permanent staff. It should meet at least twice a year and make policy recommendations for consideration by the MINFA and the ECC.

(b) A sugar policy analysis unit comprising at least one professional economist should be established within the

MINFA. The most appropriate place for this unit would probably be under the Sugarcane Commissioner's office whose scope should be enlarged to include issues relating to both sugarcane and sugar. The analysis unit would have the responsibility of data collection and processing and would provide both long and short term policy analysis for the government.

(c) The APCOM should complement its present single-crop, cost-of-production approach to pricing policies with multi-crop approaches which take into account the effect of cane support price policies on other crops.

7. CONCLUSIONS

7.1 Modifying the Goal of Self-Sufficiency in Sugar

Attaining self-sufficiency in sugar production has been a formal government goal for some time. In order to achieve this goal, the government has encouraged sugar manufacturing by maintaining high domestic prices relative to the cost of imported sugar through a government monopoly and, later, regulatory duty on imports. At the same time, sugarcane prices have been supported at fairly high levels relative to other crops. Largely as a consequence of this, sugarcane production has grown by over 4% per annum over the last 40 years. This growth, however, has been associated entirely with area expansion and sugarcane yields have been essentially static since the 1970s.

Part of the increase in sugarcane acreage has come from increases in cropped area made possible by an expansion in irrigation water supplies. Part of it, however, has also come from acreage under other crops. Sugarcane acreage has grown in the Punjab cotton/wheat and mixed crop zones and the Sind IRRI rice/wheat zone. To the extent that sugarcane has displaced cotton, IRRI rice or wheat, foreign exchange savings due to import substitution in sugar have occurred at the expense of foreign exchange earnings/savings from the production of these other crops. Since it is an annual crop, sugarcane usually displaces both crops in a cropping rotation. When these latter "costs" are taken into account, the overall foreign exchange savings from producing sugarcane are substantially reduced.

Another matter of concern is that, despite high support prices, sugarcane production has stagnated in recent years, although there has been some recovery in the last two years. The combination of high support prices and low sugarcane and sugar yields per hectare has meant that Pakistan is a relatively high cost producer of sugar by international standards. Domestic sugar production essentially continues to be subsidized by consumers who pay higher prices for sugar than would be the case if it were imported. At the same time, the goal of self-sufficiency remains as elusive as ever. Fuelled by population and income growth, the demand for refined sugar has increased more rapidly than domestic production. Consumption of sugar has been growing particularly rapidly since it was de-rationed, at first partially in 1981, and then completely in 1984. In recent years, the government has had to resort to large imports in order to meet domestic production shortfalls and moderate upward pressures on retail sugar prices.

The economic costs and benefits of the GOP's sugar policy are summarized in Table 7.1. As shown by this table, the subsidy provided by consumers towards supporting the current sugar

program is substantial. In 1987, Pakistan consumers had to pay an extra Rs. 7 billion for sugar as a result of the difference between import and domestic prices. The amount of subsidy, however, varies from year to year and may even become negative if world prices of sugar exceed domestic prices.

TABLE 7.1 COSTS AND BENEFITS OF THE CURRENT SUGAR PROGRAM

Year	Subsidy by Consumers [1]	Government Revenues		
		Import Taxes	Excise Duties	Total
	million rupees			
1985-86	6310	1161 [2]	2300	3461
1986-87	7155	2998	1800	4434

[1] Domestic sugar consumption multiplied by the difference between domestic price and import cost of sugar adjusted for distribution costs

[2] Estimated by multiplying the quantity of sugar imported by the unit import duty

Source: Explanatory Memorandum on the Budget, 1986-88, Finance Division; Foreign Trade Statistics of Pakistan, Statistics Division; Pakistan Economic Survey, 1987

The benefits to the government from the current sugar program comprise revenues from taxes on domestic production and imports. These are significant and represent an important form of taxation on a product which does not represent a large proportion of consumer expenditures. However, the tax is not entirely efficient in the sense that it captures only half of the consumer cost. The remainder of the consumer cost goes to support cane and processing costs.

Given the above, the obvious question which arises is: should Pakistan continue to strive towards achieving and maintaining self-sufficiency in sugar or should it eventually phase out domestic production in line with the principles of comparative advantage? There are three arguments for maintaining some domestic capacity in sugar production. The first revolves around considerations of food security in an environment of volatile inter-

national commodity prices. Being a basic consumer item, sugar is a strategic commodity; a domestic production capacity would reduce Pakistan's dependence on imports and vulnerability to the sudden price hikes which have characterized the international sugar market in the past. The second argument is based on the fact that Pakistan has built up a large investment in the sugar industry in the form of plants, machinery and other infrastructure. It makes little sense for it to write off this investment prematurely.

The third reason for wanting to continue to produce sugar domestically is that, despite low yields, Pakistan's sugar production costs are not very much out of line with international prices if subsidies provided by other countries are taken into account. Domestic production costs excluding excise taxes were only 47% (in Sind 38%) higher than the C&F cost of imported sugar in 1986. Higher yields or higher international prices can both make Pakistan competitive in sugar production.

The econometric analysis in Chapter 5 indicated that sugarcane and sugar prices will both have to increase considerably if the GOP wants to achieve self-sufficiency in sugar production. Since Pakistan's production costs are already above international prices, increasing production by raising support prices is clearly undesirable. This is especially so since higher sugarcane production may come at the expense of other crops such as cotton and, therefore, have high opportunity costs.

This suggests that the goal of what the National Commission on Agriculture report calls "regaining self sufficiency in sugar production" needs to be qualified by the question: at what cost? An alternative goal for Pakistan may be to continue to produce say 60%-70% of its domestic requirements with the balance being met from imports. One benefit of placing more reliance on imports, is that the government will be able to derive substantial revenues from import duties (as it does presently) as long as international prices remain below domestic prices.

What specific proportion of domestic requirements should be met by local production depends, in part, upon the level of risk that policymakers are willing to take. In the U.S. these risks have often been assessed in terms of potential domestic price increases if a worst case scenario, i.e. no imports, is assumed. The policy simulation model indicates that if Pakistan were able to attain and hold an 80% self-sufficiency level and a world shortage foreclosed the availability of imports, domestic sugar prices would likely rise by about 50%. If Pakistan held a 70% self-sufficiency level and imports were not available, prices could rise by 75%. Likewise, at 60% self-sufficiency and no imports, prices would likely rise by 100%.

At the same time, a goal of near self-sufficiency in sugar production is likely to have another effect. The price umbrella provided to support sugar production could encourage the production of alternative sweeteners. Rice and corn based liquid sweeteners, for example, are particularly suited for industrial purposes such as beverage manufacturing and food canning industries. On the other hand, low calorie sweeteners such as saccharin and aspartame are likely to appeal to a small but growing diet-conscious segment of the sweetener market in Pakistan. As in other countries, these sweeteners may eventually replace sugar in many of its present uses.

7.2 Improving Sugarcane and Sugar Yields per Hectare

Even if something less than total self-sufficiency is aimed for, it is important to maintain the growth in sugarcane production and to increase the sugar yield per hectare of cane. Although sugar production has doubled since 1979, total sweetener consumption per capita has remained constant, or has even declined somewhat because sugar production has displaced gur production. In order to increase the Pakistan sweetener supply and support a growing level of consumption, cane production and yields will have to increase.

Sugarcane yields in Pakistan are among the lowest in the world, though it is also a fact that the crop occupies the land for a shorter period than in other countries. The sucrose content of the cane grown is also low relative to other major sugarcane producing countries. Low sugarcane and sugar yields per hectare are the single most important contributor to the high production cost of sugar in Pakistan. Since sugarcane support prices are already fairly high, it is important that production increases in the future should depend primarily on improvements in yields and not increases in support prices.

Most observers agree that there appears to be considerable potential for increasing sugarcane yields and therefore reducing production costs in Pakistan. This potential is based on two factors: closing the yield gap which exists between "average" and "progressive" farmers, and evolving improved higher yielding varieties suited to Pakistan's growing conditions. Large progressive farmers are reported to achieve consistently higher yields than the majority of small sugarcane growers who tend to be poor, with limited access to key inputs such as fertilizers, pesticides, credit, and water. Many farmers also follow sub-optimal agronomic practices partly as a result of the existing cane payment system. Improving small farmer access to necessary inputs, combined with the provision of more effective extension advice, can go a long way towards raising sugarcane yields. Yields can also be increased if production continues to shift to the Sind

which has more favorable agro-climatic conditions for sugarcane cultivation.

Improvements in sugarcane yields can also come from the development of new and better varieties. Crop research and varietal development in sugarcane have noticeably lagged behind those of other crops such as wheat, rice and cotton, for which new varieties have been developed and released, raising production to new levels in each case. In contrast, minimal support has been given by the government and industry to improving cane varieties. A major R&D effort in the sugarcane sector is now needed; otherwise sugarcane yields will fall further behind those of other crops.

This is important because crop profitability depends not only upon output prices but also upon yields. The recent dramatic increases in cotton yields are likely to put greater pressure on sugarcane in Pakistan's farming systems. If sugarcane yields do not keep up with yield improvements in other crops, much larger support price increases will be required to induce the same production response as in the past. An important step in redressing the past neglect of research in sugarcane would be the creation of a sugar research institute which has been advocated for many years by the industry and by independent reports. Funding for this institute could come from the existing cane development cess with perhaps an additional nominal levy on domestic sugar production.

At the same time, the full benefits from crop and varietal research in sugarcane are likely to be realized only if the existing cane payment system is changed to one which rewards farmers for improving the sugar content of cane. Pakistan is one of the few major cane producing countries in the world where cane growers are paid on the basis of weight and not the sugar content in cane. The "quality premium" currently payable by mills is more a mechanism for sharing processor's profits than an inducement for individual farmers to improve cane quality.

The present system of payment for cane by weight results in many undesirable agronomic practices on the part of farmers which reduce sugar yields per hectare. It also provides little incentive for them to adopt cane varieties which have a higher sucrose content. Although, given the large number of small growers supplying cane to sugar mills, there are practical difficulties in moving to a payment system based on the individual sampling of cane, this system will eventually have to to be adopted if Pakistan wants to increase the yield of sugar per hectare.

7.3 Reviewing Government Regulations

Considerable deregulation of the sugar industry has taken place

over the last few years. Price and distribution controls on refined sugar were lifted and rationing abolished; a government monopoly on imports was replaced by a regulatory duty on sugar imports; the mill zoning system was discontinued; and the sugar industry was removed from the list of Specified Industries for which investment sanctions are required.

Other regulations, however, continue to exist, the most important of which is location approval from the government for setting up new mills. The GOP is apparently examining ways to make the process of obtaining location approval simpler. One proposal under consideration is to make public a list of approved sites for new sugar mills from which investors can choose with no formal reference being necessary to any official agency. A better approach would be to prepare and publish a 'negative' list: a list of areas where, for various reasons, sugar mills should not be established. This would have the advantage of placing the responsibility of site selection clearly on the investor.

While the GOP should strive to remove all unnecessary controls and restrictions on the sugar industry, other regulations and policies designed to encourage sugar manufacturing should also be reviewed. The principal ones in this regard are tax exemptions available to sugar mills and the lending policies of banks for the sugar industry.

Current excise tax exemptions given to both new and old mills need to be re-assessed in terms of their impact on production, efficiency and competition within the industry. The high debt-equity ratios in which sugar mills are financed also need to be reviewed. They result in low contributions by private investors towards the capital costs of new mills and a consequent disproportionate amount of risk being borne by the public sector. The provision of subsidized loans to the sugar industry is another policy which merits re-consideration.

Finally, in the wake of deregulation, there is also a need for new regulations to improve and maintain competition. These include laws to prevent collusion on prices and market shares, legislation to require content and quality labeling and warranting of products, and regulations to support fair trade practices. The problems associated with these types of regulations may not have manifested themselves in the sugar industry so far. However, experience in other countries shows that the absence of such regulations encourages market participants to behave in a manner which largely negates the benefits expected from deregulation.

A NOTE ON THE 1987-88 CRUSHING SEASON

At the time of going to press, preliminary information about the 1987-88 crushing season has become available. It appears that the industry has achieved a record level of sugar production, estimated at about 1.8 million tons. This is up 38% from the previous year's level of 1.3 million tons. However, it is still short of domestic consumption, estimated at 1.9 million tons for 1987-88.

What is noteworthy is that the increase in sugar production does not appear to be based upon an increase in cane production. Cane production grew by only 4.4% from 29.9 million tons in 1986-87 to 31.2 million tons in 1987-88. Higher cane production thus can account for, at most, one fourth of the increase in sugar production. Over three fourths of the increase seems to have come from diverting cane from alternative uses, principally the production of other local sweeteners such as gur, shakkar and desi cheni.

Since almost all the sweeteners produced in Pakistan are based on cane, as the table below shows, total sweetener production has probably grown by only 0.4% over last year and declined by 2.6% in per capita terms.

SWEETENER PRODUCTION IN PAKISTAN, FY87-88

Product	1986-87	1987-88	%
	---'000 metric tons---		Growth
Sugar	1,286	1,781	38.5
Gur, shakkar & cheni [1]	1,115	629	-43.6
Total sweeteners	2,401	2,410	0.4
Per capita (kgs)	23.8	23.2	-2.6

[1] Estimate in gur equivalent terms

Total sweetener production did not grow by as much as cane production because the recovery rate of gur from cane is higher than that for white sugar. Even in terms of sucrose yield, the recovery rates for gur are comparable with those of sugar mills. This is because the delay in crushing reduces the sucrose yield from cane obtained by the mills. Also, the higher extraction

rates of the latter are largely offset by subsequent processing where some sugar is lost in molasses.

Most of the increase in sugar production has occured in the Punjab and the NWFP where mills have crushed a much larger proportion of cane production than in previous years. The major reason for this appears to be lower gur prices relative to those for cane purchased by sugar mills. Gur prices during July to March 1987-88 were about 18% lower than those for the corresponding period in 1986-87. Historically, there has been a decline in gur production and consumption as sugar has replaced gur in consumer diets. However, if gur production falls below its trend rate of decline or there is a short crop year, gur prices may rise. Higher gur-cane price ratios could result in reduced cane supplies to the mill sector and consequently lower sugar production in future years -- as happened in 1985-86.

As shown above, despite the considerable increase in sugar production in 1987-88, there has been no significant increase in either cane output or total sweetener production. As such, the analysis and conclusions presented in this report are not thought to be substantially affected.

APPENDICES

APPENDIX A: TABLES

TABLE A.1 AREA, PRODUCTION AND YIELD OF SUGARCANE IN PAKISTAN, 1948-87

FISCAL YEAR	AREA (000 Hectares)				PRODUCTION (000 M.Tons)				YIELD (M.Tons/hectare)			
	Punjab	Sind	NWFP	Pakistan	Punjab	Sind	NWFP	Pakistan	Punjab	Sind	NWFP	Pakistan
1948	134	7	49	189	3972	195	1363	5529	29.7	28.3	27.8	29.2
1949	145	9	44	197	5446	256	1245	6947	37.7	30.1	28.2	35.2
1950	170	8	41	219	6409	273	1166	7849	37.7	33.8	28.2	35.8
1951	150	5	33	188	4339	231	937	5506	28.9	43.8	28.6	29.2
1952	143	6	41	190	4064	241	1094	5399	28.4	42.5	26.5	28.4
1953	193	7	53	253	5555	280	1431	7266	28.8	38.5	27.0	28.7
1954	230	13	50	292	7034	532	1390	8956	30.6	42.4	27.7	30.6
1955	244	13	48	304	6959	419	1458	8836	28.6	32.3	30.5	29.0
1956	225	13	49	287	6323	508	1369	8199	28.1	39.2	28.2	28.6
1957	245	16	58	319	6769	617	1562	8947	27.6	38.1	27.0	28.0
1958	318	19	61	398	8375	1001	1918	11294	26.3	53.7	31.6	28.4
1959	334	21	73	428	9194	886	2409	12489	27.5	42.9	32.9	29.2
1960	311	20	65	397	7855	833	1974	10662	25.2	41.2	30.3	26.9
1961	302	23	63	388	8826	906	1908	11641	29.2	39.3	30.2	30.0
1962	353	30	61	445	11136	1201	2020	14357	31.5	39.6	33.0	32.3
1963	404	58	70	531	13479	2421	2539	18439	33.4	41.8	36.5	34.7
1964	360	48	70	478	11758	1889	2492	16140	32.7	39.5	35.4	33.8
1965	358	66	79	503	12740	2717	3210	18668	35.6	41.2	40.7	37.1
1966	443	70	35	598	15959	2877	3472	22309	36.1	40.8	41.0	37.3
1967	478	81	90	650	15691	2996	3294	21982	32.8	36.8	36.5	33.8
1968	368	60	76	504	13249	2400	3011	18660	36.0	39.8	39.6	37.0
1969	396	68	77	541	16155	2778	3038	21971	40.8	40.8	39.7	40.6
1970	455	83	82	620	19713	3396	3258	26369	43.3	40.7	39.8	42.5
1971	476	79	81	636	16834	3239	3093	23167	35.4	40.8	38.2	36.4
1972	391	76	86	552	13775	2785	3402	19963	35.2	36.9	39.6	36.1
1973	367	79	87	534	13727	2915	3304	19946	37.4	36.9	38.0	37.4
1974	454	102	90	646	16618	3795	3497	23911	36.6	37.3	38.9	37.0
1975	474	105	94	673	14810	2767	3663	21242	31.2	26.4	39.1	31.6
1976	500	106	94	700	18268	3586	3691	25547	36.5	34.0	39.1	36.5
1977	575	119	94	788	21788	4037	3695	29523	37.9	34.0	39.2	37.5
1978	607	120	95	823	22096	4260	3719	30077	36.4	35.4	39.1	36.6
1979	537	121	95	753	19344	4374	3606	27326	36.0	36.2	38.0	36.3
1980	501	130	87	719	19414	4664	3417	27498	38.7	35.9	39.2	38.3
1981	598	136	91	825	23733	5007	3598	32359	39.7	36.8	39.8	39.2
1982	670	174	101	947	25021	7463	4057	36580	37.3	42.9	40.1	38.6
1983	628	180	100	912	20882	7546	4018	32534	33.2	41.9	40.1	35.7
1984	614	177	105	897	22836	7357	4065	34287	37.2	41.5	38.8	38.2
1985	626	181	96	904	20959	7428	3722	32140	33.5	41.1	38.8	35.6
1986	511	178	91	780	16755	7533	3553	27856	32.8	42.4	38.9	35.7
1987	na	na	na	762	na	na	na	29917	na	na	na	39.3

na = not available

Source: Ministry of Food and Agriculture

TABLE A.2 PER ACRE PHYSICAL INPUT-OUTPUT RELATIONSHIP IN PAKPATTAN AREA OF PUNJAB PROVINCE

Description	Unit	Rice Irri	Rice Basmati	Cotton	Kharif Fodder	Maize	S.Cane	Orchard	Wheat	Oilseed	Rabi Fodder	Vege-tables
Manual labor	Hours	241	241	226	82	182	396	248	158	112	197	200
Bullock labor	Hours	73	73	71	26	55	113	91	119	90	61	20
Nitrogen	Nut.Kgs	30.2	30.2	29	10	20	31	34	32	12	12	10
Phosphate	Nut.Kgs	13.1	13.1	10	1	6.2	14	23	14	4	4.5	5
Seed	Kgs	4.6	6.5	4.9	24.6	11	1790	115.2	38.9	2.5	10.5	57.6
Pesticides	Rupees	11.52	25	57.6	0	0	73.74	230.4	0	34.56	0	86.4
Interest rate	Rupees											
Payment to artisans***	Rupees											
Land rent****	Rupees	143.75	143.75	143.75	143.75	143.75	287.5	287.5	143.75	143.75	143.75	143.75
Other taxes	Rupees	47	49.5	46.6	28.6	33.2	83	110	38.6	37	26.2	55
Main product	Kgs	761.41	545	447.88	5635.92	373.24	13847	4000a	783.81	302.32	15639	2000a
By-product	Kgs	761.41	545	1791.52		1492.96	1384.7		783.81			

Source: Chaudhry, M. A. (1985)

a. expressed in value terms.

* Since 1984 data were expressed in monetary terms, GDP deflator was used to convert 1984 data into 1987 values.

** 14 percent on cash inputs. For each crop, adjusted for the length of crop season.

*** 1 percent of gross income.

**** Opportunity cost of land is charged -- calculated on the basis of dryland wheat.

TABLE A.3 FINANCIAL PRICES OF INPUTS AND OUTPUTS (RS per KGS) FOR THE YEAR 1987

Description	Price (RS/Unit)	Rice Irri	Rice Basmati	Cotton	Kharif Fodder	Maize	S.Cane	Orchard	Wheat	Oilseed	Rabi Fodder	Vege-tables
Manual labor	3.00											
Bullock labor	4.00											
Nitrogen	5.62											
Phosphate	5.07											
Seed		2.80	4.60	4.27	3.75	3.13	0.32	1.00	3.03	4.70	14.71	1.00
Pesticides	1.00											
Interest rate												
Payment to artisans												
Land rent	1.00											
Other taxes	1.00											
Main product		1.35	2.42	4.83	0.13	2.09	0.25	1.00	1.90	3.80	0.16	1.00
By-product		0.08	0.08	0.08		0.08	0.10		0.16			

Source:

1.Manual and bullock labor: personal interview with farmers and extension agents of the project area.

2.Fertilizer: Pakistan Economic Survey 1987.

3.Seed: Punjab Seed Corporation (for major crops) and market rates (for minor crops).

4.Output prices: Government fixed prices published in Pakistan Economic Survey,1987 (for major crops) and market rates (for minor crops).

All prices adjusted to farm gate.

TABLE A.4 FINANCIAL COSTS AND RETURNS OF VARIOUS CROPS IN PAKPATTAN AREA, 1987

(Rs Per Acre)

(Rupees)

Description	Rice Irri	Rice Basmati	Cotton	Kharif Fodder	Maize	S.Cane	Orchard	Wheat	Oilseed	Rabi Fodder	Vege-tables
PRODUCTION COST											
Manual labor	723.00	723.00	678.00	246.00	546.00	1188.00	744.00	474.00	336.00	591.00	600.00
Bullock labor	292.00	292.00	284.00	104.00	220.00	452.00	364.00	476.00	360.00	244.00	80.00
Nitrogen	169.72	169.72	162.98	56.20	112.40	174.22	191.08	179.84	67.44	67.44	56.20
Phosphate	66.42	66.42	50.70	5.07	31.43	70.98	116.61	70.98	20.28	22.82	25.35
Seed	12.88	29.90	20.92	92.25	34.43	572.80	115.20	117.87	11.75	154.46	57.60
Pesticides	11.52	25.00	57.60	0.00	0.00	73.74	230.40	0.00	34.56	0.00	86.40
Interest rate	18.24	20.37	20.45	10.75	12.48	124.84	91.46	25.81	9.38	17.13	15.79
Payment to artisans	10.92	13.65	23.04	7.33	9.00	35.73	40.00	16.15	11.49	25.02	20.00
Land rent	143.75	143.75	143.75	143.75	143.75	287.50	287.50	143.75	143.75	143.75	143.75
Other taxes	47.00	49.50	46.60	28.60	33.20	83.00	110.00	38.60	37.00	26.20	55.00
Total Cost	1495.45	1533.31	1488.05	693.94	1142.69	3062.81	2290.25	1542.99	1031.65	1291.81	1140.09
INCOME											
Main product	1030.95	1321.08	2161.02	732.67	780.07	3434.06	4032.00	1489.24	1148.51	2502.24	1728.00
By-product	60.91	43.60	143.32	0.00	119.44	138.47	0.00	125.41	0.00	0.00	0.00
Total Income	1091.86	1364.68	2304.34	732.67	899.51	3572.53	4000.00	1614.65	1148.51	2502.24	2000.00
NET INCOME											
Case 1:	-709.84	-474.88	510.04	-267.52	-549.43	-102.78	1097.25	-234.59	-189.38	904.18	553.66
Case 2	-403.59	-168.63	816.29	38.73	-243.18	509.72	1709.75	71.66	116.87	1210.43	859.91
Case 3:	766.08	1003.77	1945.09	539.80	675.57	2472.94	3145.25	1181.55	968.10	2214.20	1703.66

Case 1: All costs included; but land valued at market rental rate.

Case 2: All costs included; but land valued at its opportunity cost.

Case 3: Only cash costs included.

Table A.5 Outputs Produced Under the Optimal LP Solution

Activities	Quantity (acres/#)	Output (Kgs)
A. Crop Production		
Rice	0.02	12.32
Cotton	6.26	1908.00
Kh.fodder	2.02	11393.89
Kh.veg	0.05	100.00*
Sugarcane	2.02	27966.87
Wheat	11.48	7558.11
Rb.fodder	2.01	31550.72
Orchard	0.50	2000.00*
Rb.veg	0.05	100.00*
B. Livestock		
Bullocks	2.00	-
Buffalo	1.00	-
Cow	2.00	-
Sheep	2.00	-
Donkey	1.00	-
C. By-Products		
Wheat straw (feed)	-	5117.10
Wheat straw (sell)	-	2440.98
Rice straw (feed)	-	12.31
Rice straw (sell)	-	-
Scane tops (feed)	-	2796.68
Scane tops (sell)	-	-
Cotton sticks	-	7542.06
Bufflow milk	-	1161.00
Cow milk	-	1904.00
Beef	-	66.00
Mutton	-	16.00

* Figures in rupees.

Table A.5 Supply Response to Sugarcane Price on 20 Acre Farm Derived Through Parametric Programming

Price (Rs/40 Kgs)	Area (Acres)
9.86	2.02
9.87	2.04
10.10	2.07
11.67	2.77
13.29	2.80
13.32	2.92
14.45	3.27
18.43	3.53
20.59	3.65
23.14	3.72
24.68	3.86
25.23 a	4.84
28.68	5.29 c
53.58 b	6.15 c
158.61	4.48 c

a. Beyond this price, area under sugarcane increased rapidly because some stressed production activities became profitable to grow at the margin.

b. Beyond this price, although area under sugarcane declined, production increased. This implies that unstressed production activities dominated the optimal solution.

c. There are a series of price-quantity relationships that fall in between the last three solutions. For simplicity, only these points are indicated.

APPENDIX B

DEZONING AND ITS POTENTIAL IMPACTS: AN INDUSTRY VIEW

Dezoning has been an emotionally charged issue for the sugar industry. While an overall assessment of the impact of dezoning must await the results of detailed studies on this issue, some of the benefits and costs associated with this policy as perceived by the industry are presented in this appendix for the interested reader. As would be expected, there are conflicting views as to the perceived final outcome from the changes in policy but they serve to identify more clearly the concerns regarding what is considered an industry in rapid transition.

The Reasons Behind Pressures For Dezoning

(a) Unsatisfactory performance of mills in the zones. These dissatisfactions were identified in previously published reports of the Agricultural Prices Commission. The points of dissatisfaction ranged from lack of prompt payment to failure to lift cane as promised, and long waits at unloading points.

(b) The reluctance of mills to share large profits with producers. Producers were aware of the profitability of some mills and they felt that mills could afford to pay higher prices for sugarcane. This was felt more strongly subsequent to decontrol when consumer rationing was discontinued and sugar prices were allowed to rise according to demand and supply.

(c) Mill location in zones inequitably defined or location in areas for political reasons rather than in adequate production areas. Some mill zones did not have sufficient cane produced to operate a plant efficiently. There were considerable economic rewards to ignore zone boundaries and purchase relatively large quantities outside a given zone. At the same time, mills did not increase prices in their own zones and did not give zone producers priority in lifting cane. Some mills refused to meet with farmer and mill representatives to rearrange zones to more adequately provide for mill requirements.

(d) There was a perceived notion that certain mills were not content to develop their own mill zone area over a period of time. They wanted immediate high levels of production in the first two years when excise tax exemptions were available. These mills could afford to pay more for cane than competing mills because of the startup tax benefits. Investors could

recoup most of their highly leveraged investment in the first two years if production was high. Thus, there was great incentive to violate zone limits and there was little fear of legal reprisals because of the ineffectiveness of the legal system.

(e) The entry of middlemen in the sugarcane marketing system caused pressure on the zoning provisions. Middlemen were of two types. One was the large plantation operator with many share croppers or renters. These owners found it rewarding to negotiate for a large group of farmers. Sales were made to the highest bidding mill or middleman and the negotiator took a share of the higher negotiated prices. The second type of middleman was the assembler or trucker who dealt with farmers to collect cane and offered it to the highest bidding mill even if cane had to be removed from established mill zones. Again, there was ineffective enforcement of the law by government regulators or through legal action.

(f) A further incentive for certain farmers to agitate against zoning was quality payments for sales to a mill. For every 0.1 percent of sugar recovery rate above an established level, mills were required to pay farmers an additional amount per maund of cane supplied. Some mills never obtained this recovery level while others were able to make such payments. The farmers wanted to deliver to the mills that paid quality premiums. The sugar content of individual growers' supplies was not assessed except on a limited basis by two mills experimenting with quality sampling devices.

Perceived Benefits or Costs of Dezoning

(1) Higher cane prices. Mills will no longer be able to regard the government announced minimum prices as the maximum prices they are willing to pay. As a result, cane prices to farmers will increase, making cane production more profitable. Higher cane prices will encourage a larger cane supply to mills.

(2) Long term low producer prices under a free zone arrangement. Although higher cane prices have been evident, since dezoning, this will be a temporary situation. When cane is in more than ample supply, the negative impacts upon small farmers are expected to be large. Mills will no longer lift all the cane in their zones and are expected to give lifting preferences to large farmers and to farmers who supply them in short supply years. Transportation costs paid by farmers will further reduce their net income.

(3) Expansion of sugarcane production at the expense of other crops. If sugarcane prices remain high to encourage expan-

sion in acreage, it will be at the expense of other crops that are also important to the economy. New mills should not be permitted in areas where important cash crops are presently grown.

(4) Movement toward contractual arrangements. There will be a movement toward contractual arrangements between large producers and mills. Large producers may be encouraged to bring additional land under irrigation. Since water is a very limited resource, if more water is applied in one area there will be less available in other areas that are currently irrigated. Since large farmers especially in Sind, tend to be located at the head of water courses they have first access to water. Less water will be available to small farmers at the tail of the canals. Cane production may disappear as an alternative cash crop for this latter group.

(5) Ability to enforce contracts. Under the Sugar Factories Control Rules, disputes relating to agreements under the Rules were referred to the Cane Commissioner for decision or, if he so directed, to arbitration. Civil and Revenue Courts had no authority to examine such disputes or question the decisions of the Cane Commissioner or Arbitration Board in this regard. Though contracts were not effectively enforced under the Sugar Factories Control Rules and penalties provided for were, in practice, almost nonexistent, zoning provided mills with some assurance that cane supplies would be forthcoming. Dezoning has created considerable uncertainty in this regard. It is unlikely that contracts can be enforced effectively in civil courts which are well known for their cumbersome procedures and lengthy delays. In these circumstances the only factor which can ensure that contracts are honored by growers and mills is the threat of losing the trust and confidence of the other party. Whether this will be sufficient to ensure the reliability of cane supplies to the mills remains to be seen.

(6) Adverse affect on sugarcane yield and sugar recovery. There is evidence in Sind that the dezoning practiced the past two years has reduced both yield and sugar content. The long distance hauling of cane resulted in stale cane. There have also been problems associated with middlemen collecting from small farmers that have harvested over a three or four day period. The inability of mills to schedule harvesting with crushing capacity has caused longer periods of waiting to unload, or cane has had to be stacked longer before processing. The longer transportation and unloading period reduced the sugar recovery rate by an average 1.5% this past season for five mills in Sind. This is equivalent to a 15%-18% reduction in sugar production. Even when sugar recovery is lower, payment to producers is not reduced because only cane weight is considered. Farmer income is reduced by weight

loss due to moisture evaporation when cane is not processed quickly. Without some zoning this type of waste will persist.

(7) Greater emphasis on improving yields.The introduction of a number of new mills has increased crushing capacity faster than expansion of sugarcane production, which has not taken place in all areas. This will provide the incentive for mills to place greater emphasis upon sugarcane yields and improvement in sugar content.

(8) Dezoning will discourage mills from developing cane production. A mill has no assurance , even with a contract, that it will receive cane produced by a grower if a higher price is offered at harvest time by an alternative buyer. Mills will discontinue whatever extension activities they have offered and they will no longer guarantee loans to farmers. This may impact small farmers more than large farmers. The default rate on mill guaranteed loans was reported to be less than 5% under zoning. This past year a default rate of over 25% was experienced by some mills. When loans are more difficult for small farmers to obtain, they will be less likely to apply inputs at rates which will result in higher yields and sugar content.

(9) Inability of mills to influence variety selection. Mills will be less likely to provide seed to growers who tend to abandon them at any time during a crushing season. Also, growers may find it more advantageous to grow low sugar yielding varieties which require less care. Mills will be reluctant to discriminate in pricing among growers of high quality cane and low quality cane because this will encourage farmers to sell to mills that do not differentiate.

(10) Cutthroat competition. If the type of competition for cane supplies that has prevailed in the past year continues, it will weaken the viability of the industry. Mills located in areas because of political considerations will find it difficult to survive. If these happen to be in areas where existing mills operate, it may cause the demise of these established mills as well. The existing competition is a short-run situation that no mill can sustain. Bankruptcy of mills will leave the public banks that have financed most of the projects with large unpaid debts. However, initial investors will have probably already reaped profits on their investment and left the industry. Failure of mills will have adverse affects on local economies. To farmers it removes sugarcane as an alternative cash crop if they are located distant from other mills. It reduces employment opportunity in the community and takes away the spending multiplier effects. There are also considerable taxes that are no longer available to the public sector.

(11) Mills will define their own boundaries. Mills will attempt to define economic boundaries, under some agreements with other mills, which will permit obtaining supplies of cane in a close proximity. This will encourage the development of the cane production in that area. There will be greater incentive to increase yields in the area rather than expand production acreage. A mill requires 40-50,000 acres of irrigated area to supply cane. It requires 30,000 harvested acreage each year --the remainder is necessary for harvest overlap and fallow.

(12) Spread of sugarcane disease and insects. Hauling cane across zones and over long distances increases the potential for spreading serious disease and insect problems. Some areas have pest problems and must go to considerable expense to control them. Costs of production increase and yields and sugar extraction rates go down.

(13) Enforcement of minimum cane prices. There is apprehension that the government will not be able to enforce the minimum prices set for cane. This is a commodity that the government does not now buy or sell. It is non-storable as well. Mills will pay the minimum price because that can be monitored at mill gates. However, there is no guarantee that farmers will receive equitable compensation when operating through third parties. Mills will also be discouraged from operating collection points away from the mill which are now net costs to them. Farmers will have to absorb additional transportation costs.

(14) Consumer concern. Consideration for the consumer has been left out of the whcle debate for and against dezoning. Higher production costs for sugar means higher consumer prices when demand is growing and imports are controlled.

(15) Greater incentive for corruption. If costs rise for raw material and transportation, mills will try to make up differences in other ways. This may encourage short weighing, delayed payments, etc.

APPENDIX C

SUPPLY/DEMAND MODEL SIMULATION RESULTS

Figures I.1, I.2 and I.3 show the actual and the model's simulated values of gur price, the quantity of cane crushed by the mill sector and per capita sugar consumption over the estimation period 1962-86. For the most part, the simulated values track their corresponding historical data series fairly closely. The exception is for the years 1980 and 1985 when in the case of both the gur price and the cane crush, large absolute errors occur between actual and simulated values.

One measure of testing how well the model fits historical data is to regress the simulated values of the endogenous variables on their actual ones in the form S = a + bA, where S are the simulated and A the actual values. A perfect fit of the model for the historical period would result in an intercept of 0, a b-value of 1 and an R-squared of 1. Results of regressing the simulated values of gur price, cane crush and per capita consumption on their actual values are shown below with standard errors in parentheses :

GURPRW = 17.75 + 0.8252(PGURPR)
(8.60) (.087)
R-Squared = .79

CCM = 542.84 + 0.898(PCCM)
(521.1) (.066)
R-Squared = .88

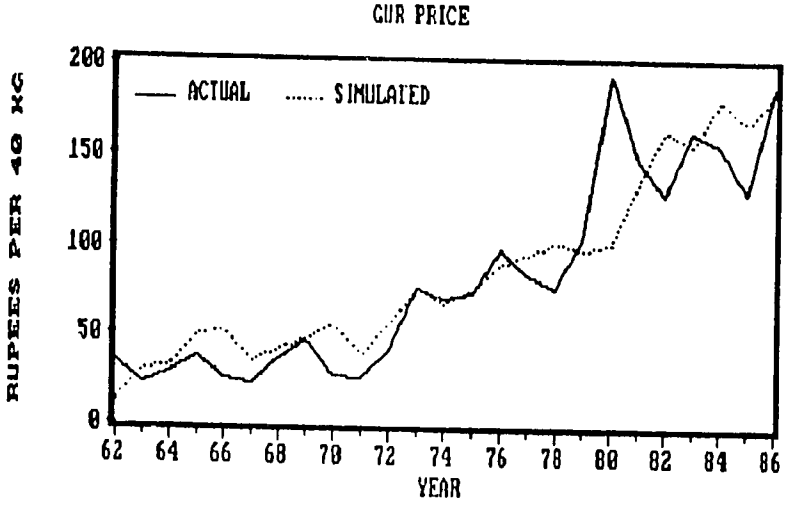
SUGCC = 0.021 + 0.943(PSUGCC)
(.71) (.078)
R-Squared = .86

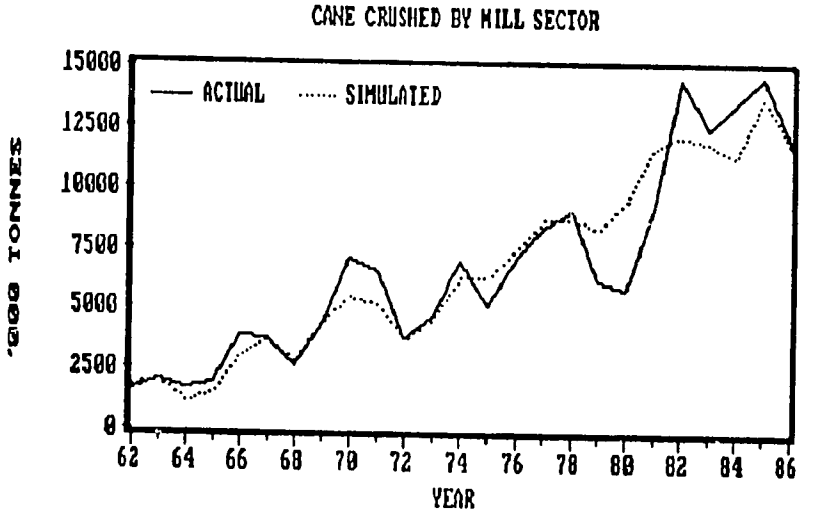
Where PGURPRW, PCCM and PSUGCC are the simulated values.

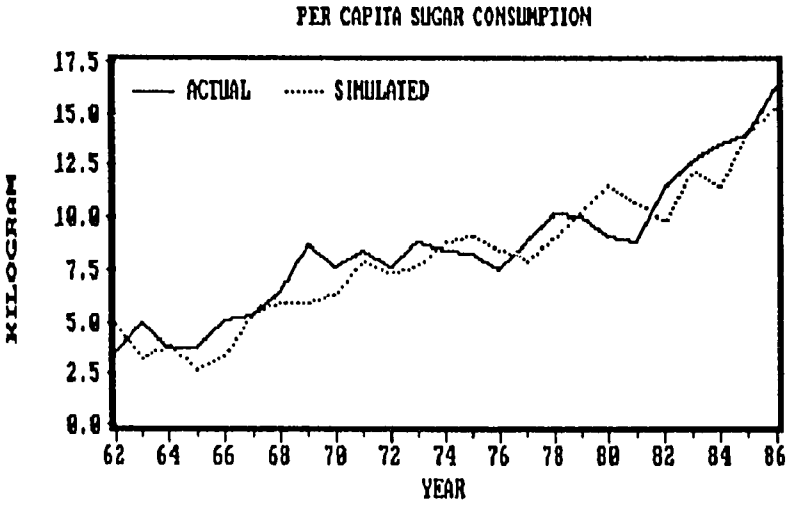
The results indicate that at the 95% probability level, none of the intercepts is significantly different than zero. However, at the 90% level, the gur price intercept is significantly different than zero. None of the b-values are significantly different than 1 at either the 90% or 95% probability level except for gur price, which is significantly different than 1 at the 90% level.

The simulated values of the gur price fit the data less well than in the case of the other two endogenous variables. One reason for this may be that the errors associated with per capita gur consumption, an explanatory variable in the gur price equation,

could be fairly large since the former is a derived estimate and not an observed value. Regression results indicated that when per capita gur consumption is replaced by cane production in the gur price equation, it explains more of the variation in the dependent variable. This suggests that cane production may be a better proxy for gur consumption than our derived estimate. However, since the purpose of the model was illustration rather than forecasting, the derived series was retained.






PER CAPITA SUGAR CONSUMPTION
ACTUAL
SIMULATED
KILOGRAM
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
62
64
66
68
70
72
74
76
78
80
82
84
86
YEAR

APPENDIX D

LIST OF MEMBERS OF THE CENTRAL SUGAR BOARD

1. Secretary,
   Food Department,
   Government of the Punjab.

2. Secretary,
   Food Department,
   Government of NWFP.

3. Secretary,
   Agriculture Department,
   Government of the Punjab.

4. Secretary,
   Industries and Mineral Development Department,
   Government of the Punjab.

5. Secretary,
   Agriculture Department,
   Government of NWFP.

6. Secretary,
   Food and Agriculture Departments,
   Government of Sind.

7. Secretary,
   Food Department,
   Government of Baluchistan.

8. Secretary,
   Industries and Mineral Development Department,
   Government of Sind.

9. Chairman,
   Pakistan Sugar Mills Association (Sind Zone).

10. Chairman,
    Pakistan sugar Mills Association (Punjab Zone).

11. Chairman,
    Pakistan Sugar Mills Association (NWFP Zone).

12. Chairman,
    Pakistan Sugar Mills Association (Centre).

13. Secretary General,
    Pakistan Sugar Mills Association.

14. Chairman,
    Sind Sugar Corporation Ltd.

15. Chairman,
    Pakistan Banking Council.

16. Chairman,
    Pakistan Industrial Development Corporation.

17. President,
    Pakistan Society of Sugar Technologists.

18. Chairman,
    Punjab Industrial Develpoment Board.

19. Cane Commissioner Sind.

20. Director Sugarcane,
    Ayub Agricultural Research Institute.

21. Director,
    Sind Sugarcane Industries Research Institute.

22. Director General, Agriculture Extension,
    Agriculture Department,
    Government of the Punjab.

23. Director,
    Sugar Crops Research Intitute, Mardan.

24. Managing Director,
    National Fertilizer Marketing Limited.

25. Deputy General Manager,
    National Fertilizer Marketing Limited.

26. Member,
    Pakistan Banking Council.

27. Deputy Managing Director,
    Pakistan Industrial Credit and Investment Corporation.

28. Director,
    Sugar Crops Research Institute, Mardan.

29. Deputy Agricultural Marketing Advisor,
    Department of Agricultural Marketing and Grading,
    Ministry of Food and Agriculture.

30. Representative,
    Pakistan Society of Sugar Technologists.

31. Representative,
    Pakistan Industrial Development Corporation.

32. General Manager,
    Punjab Industrial Development Board.

33. General Manager,
    Sind Sugar Corporation Limited.

34. President,
    Sugarcane Development and Marketing Cooperatives Federation.

35. Representative,
    Agricultural & Livestock Products Marketing & Grading Dept.

36. Managing Director,
    Pakistan Industrial Credit and Investment Corporation.

37. Growers representative (NWFP).

38. Growers representative (Punjab).

39. Growers representative (Sind).

40. Growers representative (Sind).

REFERENCES

Agricultural Prices Commission. Evaluation of Sugarcane/Sugarbeet Marketing to Sugar Mills in Pakistan. Islamabad: 1984.

Ahmad, Ehtisham and Stephen Ludlow. Aggregate and Regional Demand Response Patterns in Pakistan. Paper Presented at the Fourth Annual Meeting of the Pakistan Society of Development Economists. Islamabad: 1987.

Ahmed, Meekal Aziz, and A. Majeed Naeem. A Simulation Model for the Sugar Economy of Pakistan, 1953-83. Planning and Development Division, Government of Pakistan. 1984.

Ali, Farman. Time Series Analysis of Economics of Production of Sugarcane(1981-86). Institute of Development Studies, NWFP Agricultural University. Peshawar: 1986.

Ali, Mubarik. Supply Response of Major Agricultural Commodities in Pakistan: A Simultaneous Approach. Staff Working Paper #2, Pakistan Economic Analysis Network Project; Islamabad: 1988.

Anwar, Abdul Aziz. Production of Sugar: Policies and Problems. The Board of Economic Enquiry (Punjab). 1971.

Chaudhry, Muhammad Aslam. Economics of Alternative Irrigation, Water Allocation and Pricing Rules in Pakistan. Ph.D Dissertation. Colorado State University. 1985.

Food and Agriculture Organization of the United Nations. Report to the Government of Pakistan on Commodity Policy Study on Sugar. United Nations Development Programme. Rome: 1974

--------. Sugar: Major Trade and Stabilization Issues in the Eighties. FAO Commodities and Trade Division. Rome: 1985.

Fasihi, Shahab ud din. Some Aspects of Sugarcane Problems of Punjab. Proceedings of the 15th Annual Convention of the Pakistan Society of Sugar Technologists. 1978.

--------. Policy Issues Regarding Sugar Production in the Country. Undated.

--------. Some Economic Aspects of Cane Crushing Season.Proceedings of the 18th Annual Convention of the Pakistan Society of Sugar Technologists. 1982.

--------. Influence of Date of Harvest on the Production of Cane and Sugar in the Field. Paper Presented at the 13th Annual Convention of the Pakistan Society of Sugar Technologists. 1976.

Fasihi, Shahab ud din and M.H. Gill, A. Hussain and M. Asghar. Effect of Method of Planting on the Yield and Quality of Sugarcane Variety L:116. Proceedings of the 14th Annual Convention of the Pakistan Society of Sugar Technologists. 1977.

Fasihi, Shahab ud din and Bashir Ahmad Bukhtiar. Agronomic Aspects of Sugarcane Production. Paper Presented at the National Sugarcane Seminar, Faisalabad. 1980.

Government of Pakistan. Pakistan Economic Survey 1986-87. Economic Advisor's Wing, Finance Division. Islamabad.

--------. Monthly Statistical Bulletins (various issues). Federal Bureau of Statistics. Karachi.

--------. Agricultural Statistics of Pakistan (various issues). Ministry of Food, Agriculture and Cooperatives, Planning Unit. Islamabad.

Ilahi, K. Mushtaq. Sugar Industry of Pakistan. Pakistan Institute of Development Economics. 1978.

Landell Mills Commodity Studies. A Structural Model of the World Sugar Market. 1987.

Mian, Nurul Islam and Mohammad Ahmad Khan. Sugar Production in NWFP: Problems and Policies. Institute of Development Studies, NWFP Agricultural University. 1980.

National Development Finance Corporation. Sectoral Study of the Sugar Industry Vols. 1-4. National Develpoment Finance Corporation. 1985.

NWFP Agricultural University. Marketing of Sugarcane and Sugarbeets in NWFP: An Evaluation of Sugar Factories Control Act. 1982.

Pakistan Agricultural Research Council. Consumptive Use of Water for Crops in Pakistan. Technical Report Pk-ARS-69/FG-Pa-251. 1982.

Pakistan Council of Scientific and Industrial Research, and Denver Research Institute. Village Level Food Processing Project in Pakistan. Vol. II, Sugar. 1981.

University of Agriculture-Faisalabad. Patterns and Problems of Sugarcane Marketing to Sugar Mills in Pakistan. 1983.

United States Department of Agriculture. Sugar and Sweetener Outlook and Situation Report, March 1986. Economic Research Service. Washington DC.

Vries, Jos de. The World sugar Economy: An Economic Analysis of Long Term Developments. World Bank Staff Commodity Working Papers No. 5. World Bank. Washington DC: 1980.

Water and Power Development Authority. Feasibility Report on Command Water Management Project. 1983.