IW95-6

INTERNATIONAL AGRICULTURAL TRADE AND DEVELOPMENT CENTER

PRELIMINARY STUDY OF THE SUGAR INDUSTRIES IN CUBA AND FLORIDA WITHIN THE CONTEXT OF THE WORLD SUGAR MARKET

By
Jose Alvarez and Lazaro Peña Castellanos

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PRELIMINARY STUDY OF THE SUGAR INDUSTRIES IN CUBA AND FLORIDA WITHIN THE CONTEXT OF THE WORLD SUGAR MARKET

Abstract

The main characteristics of the sugar industries in Cuba and Florida are analyzed for the period 1980-93. In the case of Cuba, the 1990-93 period deserves separate consideration because of the changes taking place in the Cuban economy after 1989. The issue of competition and complementarity between the industries in both countries is addressed through the analysis of the problem posed by the potential restoration of part of the former U.S. Cuban sugar quota, and the current situation in world sugar markets.

Key words: CPA, Cuba, Florida, management, production costs, sugar, sugarcane, sugar quota, UBPC

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CONVERSION FACTORS[a]

To convert column 1 into column 2, multiply by	Column 1	Column 2	To convert column 2 into column 1, multiply by
0.621	kilometer (km)	mile (mi)	1.609
0.386	kilometer^2 (km^2)	mile^2 (mi^2)	2.59
2.471	hectare (ha)	acre (acre)	0.405
1.102	metric ton (mt)	U.S. ton (t)	0.9072
2.205	kilogram (kg)	pound (lb)	0.454
0.446	metric ton/hectare (mt/ha)	U.S. ton/acre (t/acre)	2.24
0.892	kilogram/hectare (kg/ha)	Pound/acre (lb/acre)	1.12

[a]All units in the Cuba section are shown as metric units. The rest of the manuscript shows U.S. units.

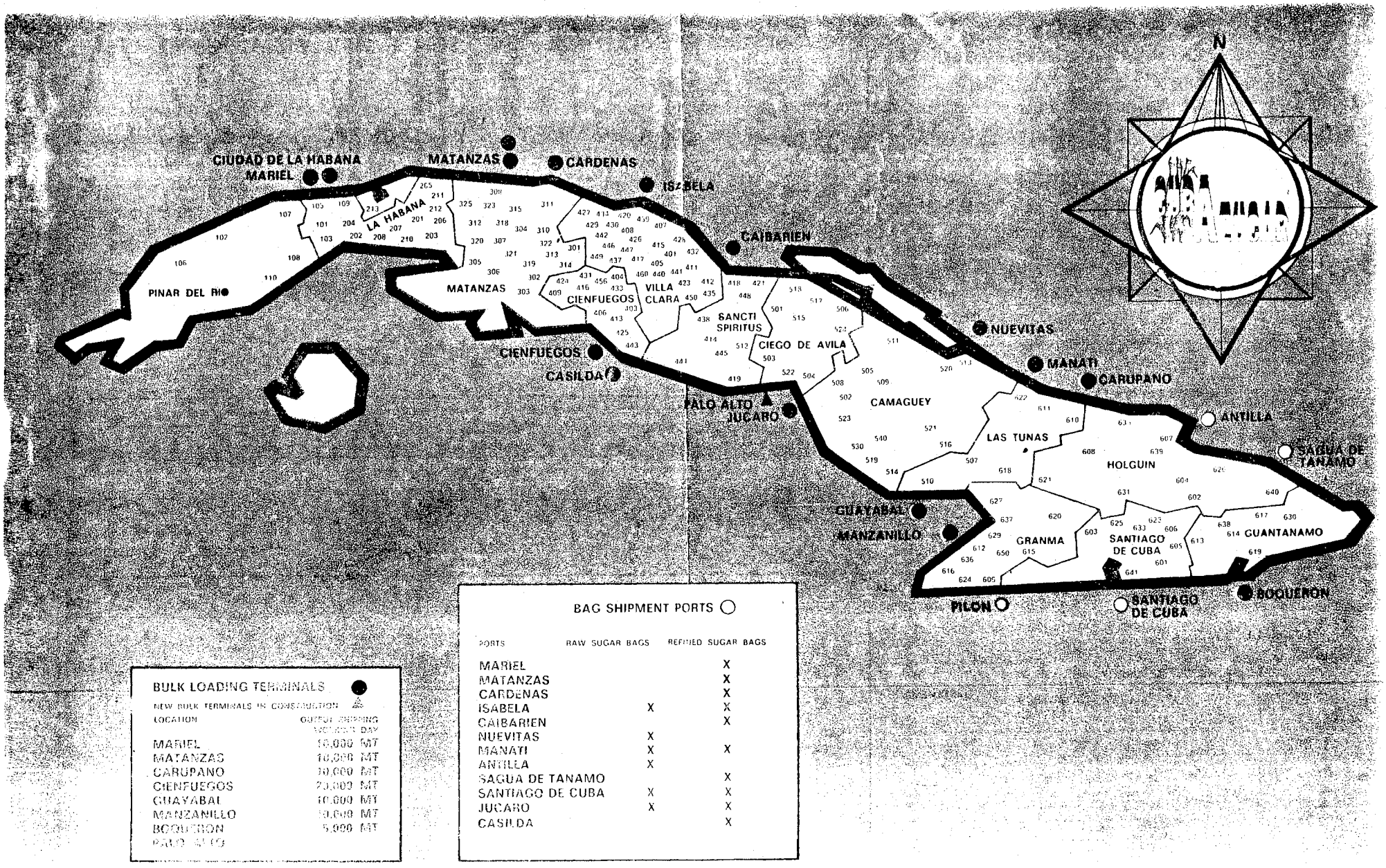


Fig. 1. Location of Cuba's sugar agroindustry.

Cuban sugar mills, refineries, and the new political-administrative division.

PINAR DEL RIO

102. Harlem
106. Manuel Sanguily
107. Pablo de la Torriente Brau
108. Jose Martí
110. 30 de Noviembre

CIUDAD DE LA HABANA

213. Manuel Martínez Prieto

LA HABANA

101. Abrahan Lincoln
103. Eduardo García Lavandero
105. Augusto César Sandino
109. Orlando Nodarse
201. Amistad de los Pueblos
202. Comandante Manuel Fajardo
203. Héctor Molina
204. Habana Libre
205. Camilo Cienfuegos
206. Manuel Isla
207. Gregorio Ariée Mañalich
208. Pablo Noriega
210. Osvaldo Sánchez
211. Rubén Martínez Villena
212. Boris Luis Santa Coloma

MATANZAS

301. México
302. Reinold García
303. Australia
304. Granma
305. Puerto Rico Libre
306. Cuba Libre
307. Jaime López
308. Humberto Alvarez
310. España República
311. Esteban Hernández
312. Fructuoso Rodríguez
313. 6 de Agosto
314. Jesús Rabí
315. José Smith Comas
318. Victoria de Yaguajay
319. René Fraga
320. Juan Avila
321. Julio Reyes Cairo
322. Sergio González
323. Horacio Rodríguez
325. José Antonio Echeverría

MATANZAS I

VILLA CLARA

401. Heriberto Duquesne
405. Luis Arcos Bergnes
407. Abel Santamaría
408. Mariana Grajales
411. José María Pérez
412. Juan Pedro Carbó Servia
415. Braulio Coroneaux
417. 26 de Julio
420. Emilio Córdova
423. Osvaldo Herrera
426. Perucho Figueredo
427. Quintín Banderas
428. Marcelo Salado
429. José René Riquelme
430. Antonio Finalet
432. Chiquitico Fabregat
434. Panchito Gómez Toro
435. Hermanos Amejeiras
437. Carlos Caraballo
439. El Vaquerito
440. Efraín Alfonso
441. 10 de Octubre
442. Héctor Rodríguez
446. Carlos Baliño
447. Unidad Proletaria
449. George Washington
450. Benito Juárez
460. Batalla de Santa Clara

CIENFUEGOS

403. Mal Tiempo
404. Ciudad Caracas
406. Guillermo Moncada
409. Antonio Sánchez
413. Espartaco
416. 14 de Julio
424. Primero de Mayo
425. Elpidio Gómez
431. Ramón Balboa
433. María Abreu
443. Pepito Tey
456. 5 de Septiembre

SANCTI SPIRITUS

414. Remberto Abad
418. Obdulio Morales
419. 7 de Noviembre
421. Aracelio Iglesias
438. Ramón Ponciano
444. F. N. T. A.
445. Melanio Hernández
448. Simón Bolívar
512. Uruguay

CIEGO DE AVILA

501. Enrique Varona
503. Orlando González
504. Ecuador
506. Bolivia
515. Ciro Redondo
517. Patria o Muerte
518. Máximo Gómez
522. Venezuela
524. Primero de Enero

CAMAGUEY

502. Ignacio Agramonte
505. Carlos Manuel de Céspedes
508. República Dominicana
509. Argentina
511. Brasil
513 Sierra de Cubitas
514. Haití
516. Alfredo Alvarez Mola
519. Cándido González
520. Noel Fernández
521. Siboney
523. Panamá
550. Batalla de las Guásimas
540. Jesús Suárez Gayol

CAMAGUEY III

LAS TUNAS

507. Colombia
510. Amancio Rodríguez
610. Jesús Menéndez
611. Antonio Guiteras
618. Perú
622. Argelia Libre

LAS TUNAS I

HOLGUIN

602. Loynaz Hechavarría
604. Lepca Peña
607. Nicaragua
608. Cristino Naranjo
621. Antonio Maceo
626. Guatemala
631. Urbano Noris
635. Rafael Freyre
639. Fernando de Dios
640. Frank País

GRANMA

609. Luis Enrique Carracedo
612. Francisco Castro Ceruto
615. Bartolomé Masó
616. Juan Manuel Márquez
620. Arquímides Colina
624. Roberto Ramírez
627. José Nemesio Figueredo
629. La Demajagua
636. Enidio Díaz
637. Ranulfo Leiva
650. Grito de Yara

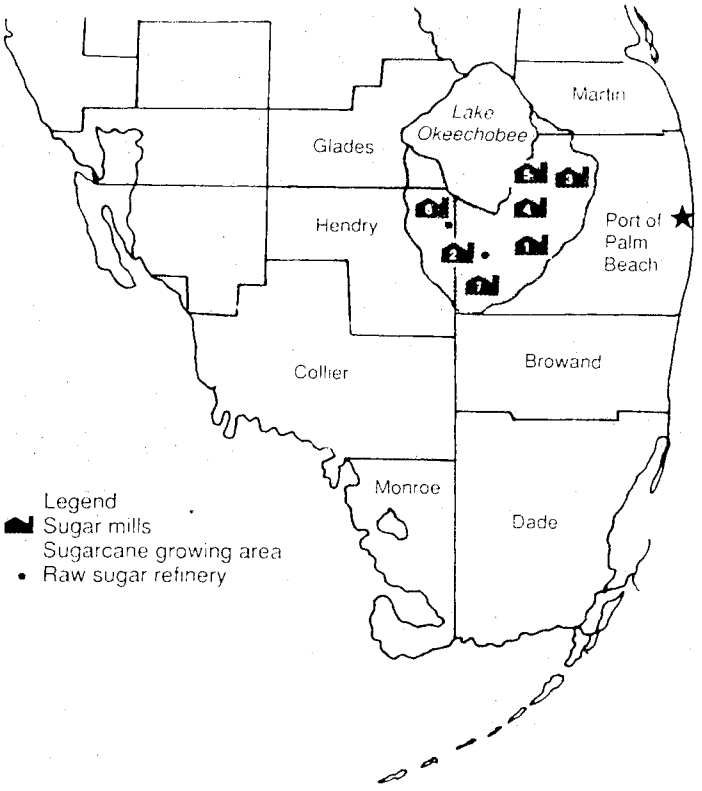
SANTIAGO DE CUBA

601. Salvador Rosales
603. América Libre
605. Los Reynaldos
606. Paquito Rosales
623. Julio Antonio Mella
625. Dos Ríos
633. Chile
641. Rafael Reyes

GUANTANAMO

613. Costa Rica
614. Argeo Martínez
617. Honduras
619. Paraguay
630. Manuel Tames
638. El Salvador

● REFINERIES



Sugar Mills	
Company	Location
1 Atlantic Sugar Association	Belle Glade
2 Okeelanta Sugar Corp.	South Bay
3 Osceola Farms Co.	Canal Point
4 Sugarcane Grower's Coop.	Belle Glade
5 U.S. Sugar Corp.	Bryant
6 U.S. Sugar Corp.	Clewiston
7 Talisman Sugar Corp.	South Bay

Fig. 2. Location of Florida's sugarcane growing area and industrial facilities.

Source: Buzzanell et al. (1992, p. 16).

PREFACE

Cuba has entered into a process of economic reforms that, combined with other factors, may lead to the restoration of diplomatic and commercial relations with the United States. Once (and for whatever reasons) the U.S. economic embargo is lifted, producers and processors of agricultural commodities in both Florida and Cuba will face challenges and opportunities.

The International Agricultural Trade and Policy Center (IATPC) of the Food and Resource Economics Department (FRED) at the University of Florida has entered into a collaborative research agreement with the Center for Research on the International Economy (*Centro de Investigaciones de Economía Internacional -CIEI*) at the University of Havana. The final objective of the project is to identify potential areas of competition and complementarity in trade and investment between Cuba and Florida.

A preliminary and important part of that research was the identification of potential commodities or group of commodities that would become likely candidates for trade or investment once commercial relations between the two countries are resumed. Six groups were identified:

1. citrus: grapefruit, lemon, *lima*, orange, and tangerine;
2. fisheries and aquaculture;
3. vegetables: cabbage, *calabaza* (pumpkin), cucumber, garlic, lettuce, onion, pepper, plantain, and tomato; roots and tubers: *boniato* (sweet potato), *malanga* (taro), potato, and *yuca*;
4. sugar;
5. tobacco; and
6. tropical fruits: avocado, coconut, guava, mango, papaya, and pineapple.

The next step consists of conducting a thorough diagnostic of each commodity or group of commodities in Florida and Cuba. These should lead to preliminary assessments of potential competition and complementarity and further estimation of benefits and costs.

This paper does that with sugar. In addition to this English version by Alvarez and Peña Castellanos, there will be a Spanish

version by Peña Castellanos and Alvarez.

The IATPC and CIEI would like to express their gratitude to the John D. and Catherine T. MacArthur Foundation for the funds provided to carry out this collaborative and important research project, and for its continuing support. The authors would like to thank Peter Buzzanell (USDA Economic Research Service) for providing valuable information and data used in this and a subsequent report. Thanks also to Armando Alvarez Dozáguez, Federico Sulroca, Alberto Ribalta, and Pedro Pablo Acosta for their useful comments on the Cuba section, and to Jorge F. Pérez-López and Ricardo A. Puerta for their useful review of the entire manuscript. All usual caveats apply.

PRELIMINARY STUDY OF THE SUGAR INDUSTRIES IN CUBA AND FLORIDA WITHIN THE CONTEXT OF THE WORLD SUGAR MARKET

Jose Alvarez and Lázaro Peña Castellanos

INTRODUCTION

Given the tremendous importance of the sugar issue in future U.S.-Cuba trade relations, it is important to explore the production and marketing potential of the industries in both Cuba and Florida. The objectives of this report are to: (a) conduct a preliminary diagnostic of both industries; and (b) take a first look at the competition and complementarity issue by looking at the problem posed by the potential restoration of part of the former U.S. Cuban sugar quota within the current situation in world sugar markets.

The diagnostics are performed for the 1980-93 period. In the case of Cuba, the years after 1989 are considered separately because of the changes taking place in the Cuban economy since that year. The handling of the topics is not identical either. In some instances, a section may contain a lengthy discussion when compared with its counterpart. For example, the discussion of costs is longer in the Florida section than in the Cuba section. The obvious reason is lack of more information available on Cuba's costs. On the other hand, the section on organization is more detailed in the Cuba section than in Florida's because of the information made available to the researchers is complete and, in some instances, unknown to readers outside Cuba.

The competition and complementarity issue has not been fully addressed here. Because of its complexity, only its main elements have been presented. Important additional information has been reserved for a forthcoming paper that will also address sugarcane and sugar by-products and derivatives.

JOSE ALVAREZ is Professor and Extension Economist, University of Florida, Everglades Research and Education Center, Belle Glade, FL 33430-8003. LAZARO PEÑA CASTELLANOS is Assistant Researcher, Center for Research on the International Economy, University of Havana, Ciudad de la Habana, Cuba.

CUBA'S SUGAR INDUSTRY

MAIN CHARACTERISTICS OF CUBAN SUGARCANE AGRICULTURE DURING THE 1980-89 PERIOD

The State Extensive Growth Model

The 1980 decade was a period of expansion for the Cuban sugarcane sector. In fact, the indicators of area under cultivation and area harvested, and the corresponding volumes of production and value, show considerable growth when compared with previous decades (Table A-1). They are also, on the average, the highest of Cuba's sugarcane agricultural history.

The expansion of sugarcane agriculture during the 1980 decade was sustained on a model based on two basic factors: an extensive growth model, and a form of organization and management of sugarcane agricultural activity essentially under state control: the state farm; hence the name "state extensive growth model."

The basic characteristics of the model applied to the sugarcane agricultural activity in state farms were: (a) expansion of agricultural areas; (b) high capital investment; and (c) high use of productive inputs.

Expansion of Agricultural Areas

Forty-three percent of the total 4.4 million ha under cultivation in the country are currently devoted to sugarcane. No other crop has such area in Cuba.

At the beginning of the 1980 decade, the area devoted to sugarcane was more than 1.6 million ha. About 250,000 more hectares were added during that period to reach 1.9 million ha in 1990 (Table A-1).

This continued increase in sugarcane agricultural area was tied to two factors: (a) the projected increases in production levels, and (b) the still low agricultural yields. On the average, sugarcane agricultural production showed a positive growth during the 1980 decade when compared with the two previous decades. However, its production fluctuated from year to year.

This unstable behavior of sugarcane production was due, to a certain extent, to both epidemiological and climatological factors. For example, in 1979, rust severely affected the Barbados (B-4362) sugarcane variety which, at that time, was planted in more than one-fourth of the cane area (Nova González, 1990, pp. 262-301). During 1980, it became necessary to replant the affected areas and substitute the Barbados variety for others more resistant to rust, which impacted the harvests between 1979-80 through 1980-81 (Table A-1).

Climatological problems had also negative impacts on sugarcane production. Out-of-season rains (related to the so-called Niño phenomenon) in 1983, and hurricane Kate in 1985, affected the harvests from 1982-83 through 1984-85, leaving losses of about two million metric tons of sugar (Table A-1). This was followed by two years (1986 and 1987) of intense dry weather with annual levels of rainfall of 970 and 1,215 mm, respectively, well below the country's historical mean of 1,375 mm (Rodríguez Hernández, 1989, p. 24).

Despite these problems, sugarcane production averaged 71 million metric tons during the 1980 decade. This was 28% above the annual production average for the 1970 decade, and 54% above the results of the 1960 decade (Table A-1).

During the 1980 decade, there was also a favorable balance concerning average sugarcane yields, although these continued to fall well below the agricultural potential of the country. Furthermore, and as explained below, the differences between potential and actual yields were different at the provincial level.

Three groups of basic factors were taken into account in the determination of agricultural yield potentials: (a) the edaphic and climatic conditions of the areas devoted to sugarcane production; namely, rainfall patterns and soil characteristics; (b) biological factors such as insects and diseases affecting the crop, varieties, and others; and (c) the agrotechnical system used, such as crop technology, fertilization, irrigation, and others.

Concerning the conditions of Cuban soils devoted to sugarcane, out of the nine soil types where sugarcane cane activity takes place, three of them have more than 80% of the crop. These are solicious calcareous soils (brown), ferralitic calcareous soils (red and yellow), and vertisoils (dark plastic) (Sulroca, 1990, p. 3).

The specific agrotechnology applied in the search for the highest yields depends on the soil characteristics. In that sense, limiting factors include the soil's hydric regime, soil fertility and nutrition, and the technological potentials for cultural activities.

According to Sulroca (1990, p. 5), and based on the potential of yield levels and constraints of the soils, the soils where sugarcane production takes place can be broken down into four main groups:

Soil	Potential average yield	Area covered	Growth limiting factors
Good	> 84 mt/ha	9.6%	None
Favorable	75.6 - 84 mt/ha	31.7%	Little intensity
Fairly good	50.4 - 75.6 mt/ha	55.2%	Moderate intensity
Inadequate	< 50.4 mt/ha	3.5%	Strong intensity

Concerning the impact of rainfall patterns on cane agricultural yields, it is important to note that the majority (75%) of sugarcane plantations in the country are on dry (non-irrigated) lands. Thus, rainfall patterns are of extreme importance for crop growth and development.

According to Sulroca (1990, p. 13), the impact of every 100 mm of annual rainfall on agricultural yields by edaphic/climatic region, based on a normal behavior of rainfall patterns, is as follows:

Soil type	mt/ha for every 100 mm/year
Red and yellow (ferralitic)	1.155
Brown and undulated (sialitic)	2.018
Savanna quartz (quartz ferralitic)	3.550
Brown and red (solicious and ferralitic)	2.227
Plastic (vertisoils and hydromorphic)	0.943

Based on the above edaphic/climatic and limiting factors, a research project on potential agricultural cane yields was initiated at the national level in 1986. The results, also evaluated at the provincial level during the 1977-89 period, showed that, while the minimum average yield potential of the country was around 77.3 mt/ha, only 51.5 mt/ha were achieved, or about 67% (Table 1). On the other hand, a close look at both participation (relative shares of cane) and average performance by province during the 1981-89 harvests (Tables A-2 and A-3), shows the following results:

(a) Only one (Habana) of the seven provinces whose shares ranged from 8 to 13% during the 1980 decade, maintained yield levels around 69 mt/ha. This province, however, only reached 77% of its average potential yield during the study period. Matanzas only achieved agricultural yields close to 59 mt/ha --a performance well below its minimum potential.[1] The remaining of this elite group of provinces (Villa Clara, Ciego de Avila, Camagüey, Las Tunas, and Holguín), did not achieve 75%, and in some cases not even 60%, of their minimum potential yields.

The cases of Ciego de Avila and Camagüey (provinces with a low population density in rural areas), and Las Tunas, are critical since they have a high average participation in the harvests and, at the same time, high minimum yield potentials. In these provinces, however, actual yields achieved during the past decade only represented 56-61% of their minimum yield potential.

(b) Average yields in the provinces of Cienfuegos, Sancti Spíritus, Santiago de Cuba, and Granma, with sugarcane shares

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[1]Minimum potential is defined as the minimum sugarcane yields that can be achieved with the use of simple technology.

Table 1. Potential and actual sugarcane yields by Cuban province, 1977-89.

Province Country	Potential minimuim yield	Average actual yield	Actual/ potential
		-mt/ha-	
Pinar del Río	71.4	57.2	80.1
Habana	89.9	69.0	76.7
Matanzas	85.7	58.6	68.4
Villa Clara	69.7	49.7	71.3
Cienfuegos	74.8	50.4	67.4
Sancti Spíritus	70.6	45.9	65.1
Ciego de Avila	80.6	49.7	61.7
Camagüey	84.8	48.5	57.2
Las Tunas	77.3	44.5	57.6
Holguín	70.6	47.0	66.7
Granma	72.2	53.8	74.5
Santiago de Cuba	79.8	55.9	70.1
Guantánamo	77.3	48.1	62.2
Country	77.3	51.5	66.6

Source: Sulroca (1990, p. 17).

between 4 and 7%, were always below 57 mt/ha, and around 48 mt/ha in the case of Sancti Spíritus.

(c) Pinar del Río and Guantánamo, provinces with an average share of sugarcane below 3%, showed different performances. Pinar del Río ranked as a medium-yield province (58.6 mt/ha) with a minimum average potential of 71.4 mt/ha. Guantánamo, on the other hand, with a high minimum yield potential (above 77.3 mt/ha) only achieved levels of 46.6 mt/ha, which represented 40% below its minimum potential.

When average agricultural yields for the 1981-85 and 1986-90 periods are compared, the drop of about 1.90 mt/ha becomes obvious (Table A-3). Therefore, average agricultural yields were not only relatively low but also showed a decreasing tendency during the 1980 decade. However, as already pointed out, the volumes of cane milled during the decade were increasing (Table A-1). This was only possible by increasing cane area and, above all, by increasing harvested areas. In other words, the increase in the volumes of sugarcane milled during the 1980 decade were the result of extensive plantings.

Other theoretical and empirical studies have been conducted in Cuba that give credibility to the possibility of achieving average yield levels above 67.2 mt/ha. For example, between 1970 and 1985, numerous experiments were conducted at several agroindustrial complexes (Pablo Noriega, Mañalich, Habana Libre, América Libre, among others), with the objective of measuring yield potentials for sugarcane based on the implementation of intensive cultural methods and integral care to the crop. All the experiments confirmed that, through the implementation of intensive cultural practices, and an efficient system of organization and management, it was feasible to achieve average country yields above 67.2 mt/ha (Alvarez Dozáguez, 1993, p. 5). (See also Table A-3.)

High Capital Investment

During the period 1981-89, total investments in the agricultural sector reached 7.9 billion pesos --4.2 billions during the quinquennium 1981-85 and 3.7 billions during the remaining four years (CEE, Anuario Estadístico de Cuba, 1989, p. 133). Such an investment represented 20.3% of total investment in the country during the nine-year period.

The investment level in the sugarcane agricultural sector during that period reached US$2.4 billion (1.3 billion pesos in the quinquennium 1981-85 and 1.1 billion pesos during the following four years). That figure accounted for 30% of total investments in the agricultural sector during the ten year period.

In relation to the 1976-80 period, during which investments on the agricultural sugarcane sector reached 987 million pesos, the

increase in investment in 1981-85 was 30%. However, there was a decrease of the sugar industry's share of 8% with respect to the investment in the whole agricultural sector of 2.6 billion pesos (CEE, Anuario Estadístico de Cuba, 1983, p. 135).

The continuing investment growth pattern is also observed in the last four years at the end of the 1980 decade for which data are available. In fact, average annual investment per year for the period 1981-85 was 264.5 million pesos, and 271.8 million pesos for each of the remaining four years (Table 2).

Although the investment flows for the sugarcane agricultural sector during the 1980 decade were high, the efficiency of the investment process was, however, insufficient as shown by the following facts. First, despite the increases in investment the value of gross production did not increase. The annual indicators of the value variation of sugarcane production/investment (dvp/inv) are shown in Table 3.

The annual average of the dvp/inv indicator for the years 1980-89 is only 0.05 pesos. In other words, for every peso invested in the sugarcane agricultural sector during that period, the value of production only grew an average of 5 centavos.

Second, when this indicator is analyzed for variations in milled cane at the mills (dcm/inv), the average results, measured in kg/peso invested, also show similar results (Table 4). The annual mean value for this indicator is 7.02 kg per peso invested during the years 1981-89, with a correlation coefficient between the two variables of 1.9% (0.019).

In other words, the investment flows in the sugarcane agricultural sector did not have a relevant positive impact on the increases of production values or cane volumes for the industry. The three processes lacked the necessary integration.

In general, the efficiency of the investment process was very insufficient during the period 1980-89. When compared with the first five years, the last four years of the decade show more favorable results in the three parameters. However, if both results are compared with the 1976-80 period, the latest results in production values are lower than in the last years of the previous decade, and the achievements in terms of milled cane were very modest at best.

In summary, the absence of the necessary integration in the behavior of the three parameters, the maintained increases in investment levels, and the low global efficiency of the investment process, were clear indications in the 1980 decade of the exhaustion of the state extensive growth model being applied to sugarcane agriculture.

Table 2. Investment in Cuban sugarcane agriculture, by major component and activity, 1981-85 and 1986-90.

Component, activity	Year						
	1981-85	1986	1987	1988	1989	1990	1986-90
	Million pesos						
Construct./Assembly	223.5	43.5	36.0	36.9	45.1		
Irrigat./Drainage	210.6	36.7	24.1	29.0	24.3	36.2	150.3
Equipment	514.0	106.5	79.0	85.7	82.6		
No. combines[a]		4175				4450	
No. tractors[a]		41619				53116	
Others	585.2	144.9	145.8	141.1	140.1		
Cummulative	528.4	132.9	130.0	124.1	121.3	99.8	608.1
Total	1322.7	294.9	260.8	263.7	267.8	229.8[b]	1317.0[b]

[a]Number of combines and tractors in that year.

[b]Estimates.

Sources: CEE, Anuario Estadístico de Cuba (Varios Issues); Anuario Estadístico MINAZ (1990, pp. 156, 247-255).

Table 3. Investment efficiency in Cuba's sugarcane: variation in sugarcane production value in relation to annual investment, by year 1981-89, and period 1976-89.

Year	dvp/inv	Period	dvp/Σinv
1981	0.220	1976-80	0.11
1982	0.002	1981-85	0.02
1983	0.013	1986-89	0.09
1984	-0.020		
1985	-0.169		
1986	0.126		
1987	0.095		
1988	0.288		
1989	-0.149		

Source: Calculated by the authors from CEE, Anuario Estadístico de Cuba (Various Issues).

Table 4. Investment efficiency in Cuba's sugarcane: relationship between the variation in sugarcane production volumes and annual investments, by year and period, 1981-89.

Year	dcm/inv	Period	dcm/Σinv
1981	8.13	1976-80	11.75
1982	26.37	1981-85	2.57
1983	-15.94	1986-89	12.58
1984	29.26		
1985	-35.71		
1986	3.73		
1987	8.82		
1988	10.99		
1989	27.26		

Source: Calculated by the authors from CEE, Anuario Estadístico de Cuba (Various Issues).

High Use of Productive Inputs

There was also growth in the levels of productive inputs used in the sugarcane agricultural sector during the 1980 decade. For example, there were solid increases in the area of balanced fertilizers (N-P-K), and nitrogenous fertilizers (Table 5).

There were absolute increases in fertilizer levels for sugarcane production, and in the indexes relative to the input of these nutrients during the 1980 decade. There was a strong statistical correlation between area benefiting with balanced or nitrogenous fertilizers and volumes of sugarcane production. In the case of nitrogen the correlation coefficient was 84%, while it was 46% for balanced fertilizers. Correlation coefficients between areas benefitted with nitrogenous or balanced fertilization and agricultural yields were 64% and 57%, respectively. As explained in a later section of this paper, the decrease in the availability of fertilizers since 1991 was one of the main reasons for the fast decreases in both cane volumes and yields.

The situation with herbicides was similar to the fertilizer case. There were increases in both the sugarcane area receiving herbicides and the number of applications during the 1980s (Table 6).

Sugarcane Agricultural Production Costs[2]

Cuban sugarcane agriculture experienced rising levels of production costs during the 1980s (Table 7). (See also Tables A-4 to A-6.) It was impossible to obtain a cost break-down by item for all the provinces and the country. However, such break-down was available for 1988 for the province of Villa Clara, one of the main producers of sugarcane for grinding (Table 8).

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[2]The reader should be careful when comparing costs between the two producing areas. First, Cuban costs before 1991 reflect the preferential treatment in inputs Cuba received from the former Soviet block. Second, regulatory frameworks that affect costs are different in Cuba and Florida. Finally, land charges in Cuba were practically zero before 1993 (when most lands belonged to the state) when new production cooperatives were established.

Table 5. Main fertilizer indicators in Cuba's sugarcane agriculture, 1975 and 1984-89.

Indicator	Unit	Year						
		1975	1984	1985	1986	1987	1988	1989
Area fertilized[a]								
Nitrogenous	million ha	0.6	1.2	1.3	1.2	1.1	1.1	1.2
product	metric ton	108.7	235.4	259.8	229.9	217.8	214.3	253.6
index	kg/ha	178.0	193.0	206.0	186.0	190.0	203.0	218.0
Balanced[b]	million ha	1.2	1.3	1.2	1.3	1.3	1.1	1.2
product	mt	417.9	640.6	608.5	592.2	562.4	532.8	535.6
index	kg/ha	341.0	495.0	493.0	455.0	438.0	467.0	460.0
Total cost	million pesos	NA	78.1	77.2	78.7	69.8	65.4	78.8
Nitrogenous	million pesos	NA	31.7	31.9	29.2	24.1	27.3	33.0
Balanced	million pesos	NA	46.4	45.3	49.5	45.7	38.1	45.8

[a]Includes only the first application.

[b]Basic elements include nitrogen, phosphorus, and potassium.

Sources: CEE, Anuario Estadístico de Cuba (1989, p. 190); MINAZ data.

Table 6. Sugarcane agricultural area treated with herbicides (first application) in Cuba, 1975, 1980, 1988, and 1989.

Year				
1975	1980	1985	1988	1989
		1,000 ha		
990.9	1231.3	1090.2	1117.9	1274.1

Source: CEE, Anuario Estadístico de Cuba (1989, p. 190).

Table 7. Cost indicators in Cuba's sugarcane agriculture and sugar domestic prices, 1982-90.[a]

Year	Cost/ mt cane	Indust. yield	Agric. cost/mt sugar	Price/ mt sugar
	Pesos	%	Pesos	Pesos
1982	13.67	11.17	122.19	138.89
1983	14.23	10.35	137.23	138.89
1984	13.91	10.47	132.63	161.83
1985	17.27	11.99	143.78	161.83
1986	15.50	10.62	145.67	161.83
1987	16.24	10.64	152.35	161.83
1988	14.41	10.85	132.53	161.83
1989	15.46	10.83	142.44	161.83
1990	15.89	10.65	148.90	161.83

[a]Include growing, loading, and hauling only.

Source: Calculated by the authors from MINAZ, Anuario Estadístico (1990).

Table 8. Sugarcane agricultural production costs for the province of Villa Clara, by item, 1988.

Item	Cost/mt
	Pesos
Fertilization	1.40
Transportation	2.18
Machinery and shop	2.64
Irrigation	0.46
Depreciation	2.11
Salaries and social security	3.30
Other	3.61
Total	15.70

Source: Bazán Reyes and Rivero González (1985, p. 5).

As shown in Table 8, the high hidden cost of the "other" item had a tremendous impact on the level of total costs (23% of the total), which is intimately related to the problems of efficiency and organization at the firm level.

In summary, the following conclusions can be derived from the previous sections:

> ***During the 1980s, Cuba's sugarcane agriculture developed following an extensive growth model, characterized rising land balance, use of productive inputs, capital investments, and costs. However, during that period, agricultural yields were far below the country's potential, which unveiled the existence of relevant deficiencies in the integrated care to sugarcane culture.***

Integrated Care to Sugarcane: Important Deficiencies

There are many conflicting criteria on the fundamental importance of the following elements in determining agricultural and industrial yields (Dirección de Agrotécnica MINAZ, 1983, 1985).

They are:

1. The timing of the harvest.
2. The management of the sugarcane plant.
3. The planting and replacement of sugarcane fields.
4. The integrated control of weeds.

The timing of the harvest

Timing of the harvest is defined as the time period between the beginning and the end of the sugarcane harvested for industrial purposes. These two dates are the subject of heated debates because of their impact on agricultural and industrial yields.

The historical evidence shows that, concerning industrial yields, the month of November is not advisable for starting the grinding season. The reason is that, in November and still in December, the residual humidity in the soil impacts in a negative way on the sucrose concentration of the sugarcane, translating into low industrial yields (Table 9).

Table 9. Comparison of average industrial sugar yields in Cuba during early and late harvests, 1976-80 through 1986-89.

Date	Time period			
	1976-80	1981-85	1986-89	1976-89
		-Percent-		
1-10 December	8.45	8.58	8.30	8.45
20-30 April	11.37	11.07	10.81	11.10

Source: Rodríguez Hernández (1989, p. 12).

It is obvious that a harvest lasting approximately 150 real days should not start before the 15th of December.[3] The previous statement assumes an adequate and effective organization of harvest activities under a criterion of industrial yield maximization. If there are doubts with regards to the pace, organization, and effectiveness of harvest activities, the tendency to an early start becomes strong due to the danger of prolonging the harvest until May, or even June, which are the months with the highest rainfall in Cuba.

The reason behind is that a harvest extended during the rainy season brings about a drastic reduction in industrial yields due to the following facts: (a) disruption in harvest activities, especially in mechanical cutting (during the 1980 decade, mechanical harvesting reached more than 70% of the harvest), and (b) lower polarization in the cane (decreasing pol in cane forces a higher harvest per ton of sugar). Despite these facts, every single sugar campaign started extremely early and finished extremely late from 1976 through 1989 (Table 10), and also thereafter.

[3]The 150 days reflect Cuban climatic conditions and milling capacity.

Table 10. Actual starting and ending dates for Cuba's sugarcane harvests, 1976-89.

Season	Starting date	Ending date
1976	Nov. 29	June 9
1977	Nov. 21	June 6
1978	Nov. 16	June 20
1979	Nov. 15	July 28
1980	Nov. 12	July 10
1981	Nov. 14	June 10
1982	Nov. 19	June 8
1983	Nov. 11	June 30
1984	Nov. 6	July 14
1985	Nov. 23	July 10
1986	Nov. 12	June 19
1987	Nov. 12	June 19
1988	Nov. 14	May 26
1989	Nov. 12	June 2

Source: Rodríguez Hernández (1989).

The beginning of the harvest is, therefore, a factor that impacts on industrial yields; however, the ending time is even more relevant for an efficient sugar production.

Extending the Cuban sugarcane harvests beyond April 30th (that is, to the months of May, June, and July), has been the result of three factors: (a) insufficient flow of cane to the mills (subutilization of industrial capacity); (b) insufficient cane quality (low pol content); and (c) the necessity of grinding more cane than that committed to fulfill a determined plan when actual industrial yields have been below expected yields.

Subutilization of industrial milling capacity

Rainfall is an exogenous and imponderable factor that affects the utilization of milling capacity. An out-of-season rain, during the dry period between February and March, causes severe damage to plantations and results in an extended harvest beyond the month of April. At present, there are technologies applicable to offset the damage caused by abnormal rainfalls. They range from an adequate land preparation of low soils, to the planning of planting and crop cycle based on soil type, to the utilization of specialized harvest equipment such as crawler combines, trucks equipped with tires with a high level of flotation, and others (Alvarez Dozáguez, 1993, p. 6).

However, it is important to point out that extending the crop to very low lands is, to a certain extent, a factor tied to low agricultural yields and to the increase in planted area to boost

sugarcane volumes during the harvest.

The imponderable factors, mainly rainfall patterns, are not the only ones that affect milling capacity utilization. Problems related to organization and efficiency in harvest tasks, both manual and mechanical, have also played very important roles.

Concerning hand-cut harvesting, the most relevant deficiencies have been the relative scarcity of a labor force and the level of productivity of the labor force employed. In this regard, the different methods of incentives applied during the 1980 decade, discussed later on the paper, have played an important role (Rodríguez Hernández, 1989, p. 20).

Mechanical harvesting did not achieve the required levels of productivity during the last decade either. In this case, in addition to the labor force problem (the ability and incentives of the operator), the technological characteristics of the equipments used played a fundamental role. For example, on the average, the real time lost in milling due to machinery and equipment breakdowns fluctuated between 2.5 and 3.5% during the 1981-89 period (Table A-7).

The quality of cane

Quality of cane is the second factor that impacts on the extension of the harvesting period. First, an adequate system of harvesting organization must ensure a cutting schedule, for both hand and mechanical harvesting, based on the maturity and pol content of the sugarcane. Organizational deficiencies can result in extended harvests since they cause industrial yield losses.

Second, quality of cane can stimulate a chain reaction in a progressive process of cane depopulation. In fact, an extended harvest due to low industrial yields extend the cutting to unscheduled sugarcane areas because of the sugar production plan developed or the global necessities of the economy. At the same time, the tardiness of the harvesting determines a seasonal disruption of the growing and maturing months for sugarcane and, therefore, impacts in a negative way on agricultural yields and cane availability of adequate maturity for the following harvest.

Finally, the use of cane of insufficient quality in the following harvest impacts industrial yields during the period January-April and causes another extension of the harvest.

Such a cycle has a cumulative effect and leads, in the medium-term run, to the depopulation of sugarcane areas.

Management of the Sugarcane Plant

This concept includes a group of basic rules that govern the relationship between land balance (*tierra de balance*)[4] and an adequate and efficient organization of planting activities and the integrated care of weeds that the crop requires.

In general, according to MINAZ (1990, p. 216), a sound management strategy for the sugarcane plant must fulfill the following requirements:

(a) Depending on the type of cane, the age of all sugarcane harvested must fall between 12 and 22 months.

(b) Cold cane (early cold cane planted between July and September, or late cold cane planted between October and December), must be harvested with an age ranging from 16 to 18 months. Only in exceptional cases, with less than 15 months or more than 19 months.

(c) The spring canes left unharvested (long cycle) ought to be harvested with ages between 18 to 20 months, and exceptionally with 24 months.

(d) The cane stubbles (canes with three of more cuttings) should be harvested between 12 and 15 months of age.

(e) The spring canes (canes planted between the months of January and June) that had been planted between the months of May and June, must always be harvested in the following harvest (left cane, or *caña quedada*).

An optimal management program also presupposes that the harvested area will never be above 75% of the balance area (area with cane on December 31st), which agrees with the previous harvesting rules. When this rule is not followed, sugarcane harvested in subsequent seasons starts showing a decrease in agricultural yields. Furthermore, when the area harvested is beyond 85% of the area with available cane, there is a cumulative tendency to depopulation of cane areas as a result of the continuing weakening of the cane plant.

The percentage relationship between harvested area and area with available cane on December 31 shows some fluctuations during the period 1970-90 (Table A-8). Between 1971 and 1980 (1970-71

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[4]Land balance, the land devoted to the new cane crop, includes planted area minus losses from planting, plus cane left unharvested in the previous season. The resulting figure gives the area with cane available on December 31 for the current season. For efficient management purposes, only 75% of the sugarcane available on December 31 should be harvested.

through 1979-80 seasons), this indicator averaged 79%, which means that, in order to ensure the volumes of cane necessary for the harvest, it was necessary to cut, in some years, large areas of stubbles with 1-2 harvests and cut with less than 12 months of growth, and cold and spring canes of only 14 or 15 months of age. Such a management plan can be extremely damaging because the reiteration of early cuttings in areas of short cycles can become a degrading factor of the cane plant. Such is the case of the so-called "spring cane of the year", of only 10 to 11 months of age, considered a cane of bad quality (MINAZ, Anuario Estadístico 1990, p. 216).

Between 1981-85 (1980-81 through 1984-85 seasons) this percentage decreased below 75%. This was due, in part, to the intensive plantings carried out during this period to replace areas affected with rust. Between 1985 and 1989, however, it increased again to reach 76%, and continued its increasing trend until reaching 79% during the 1990-92 period.

The influence that the harvesting of areas with different ages and cycles exerts on sugarcane yields can be illustrated with data from a study conducted in 148 sugar agroindustrial complexes during the 1976-86 harvests (Table 11).

The data clearly show that the lowest agricultural yields were obtained from spring canes and stubbles with more than two cuts, while those from cold plantings and long-cycle canes rendered the highest agricultural yields. In addition, when the comparison is made between cold canes (early cold canes are harvested between 14 and 18 months of age) and long-cycle canes (harvested between 20 and 22 months of age) the latter produced the best results.

Planting and replacement of fields

The planting and replacement of sugarcane fields have an enormous influence in the behavior of agricultural yields. They are a third important aspect of an integrated sugarcane management program. Planting constitutes a very complex activity that requires a sophisticated and efficient organization to coordinate the selection and treatment of seed, the adequate land preparation, and the quality of the planting and replanting activities.

Planting is also a very costly activity. For example, during the second half of the 1980 decade, planting costs were estimated to be between 596 and 969 pesos per hectare (Fernández Carrasco, 1990, p. 8) Obviously, such a high planting cost (in relation to total variable costs) emphasizes the need to follow economic criteria concerning planting, and stubble management and replacement.

There is an ongoing debate in Cuba concerning the programming of planting activities. In fact, the optimal planting time depends

Table 11. Comparison between the best and worst trienniums of 148 sugar agroindustrial complexes in the harvests between 1977 and 1986.

Indicator	Unit	Worst triennium	Best triennium
Area harvested	1000 ha	1332.45	1261.90
Production	1000 mt	654.32	711.02
Yield	mt/ha	49.14	56.45
soca[a]	mt/ha	47.71	52.58
stubble[b]	mt/ha	43.68	48.30
spring	mt/ha	39.90	43.76
cold	mt/ha	66.70	72.32
long cycle[c]			
spring	mt/ha	77.62	82.91
stubble	mt/ha	62.41	72.24

[a]Stubble with 1-2 harvests, cut with less than 12 months of growth.

[b]Older stubbles.

[c]Plant cane. In a long harvesting cycle, the cane has between 20 and 22 months of age.

Source: Acosta Pérez (1987, p. 14).

on the specific conditions of the soil type, rainfall patterns, and the availability of labor (MINAZ, Anuario Estadístico 1990, p. 27). It is a known fact that, in Cuba, and because of the biological characteristics of the crop and the country's climatological conditions, the planting of early cold cane renders higher yields (considered twice as high by many cane specialists) and lower levels of losses, than spring cane. It has been estimated that about 20% of the area planted in the spring is lost (Alvarez Dozáguez, 1993, p. 6). However, spring plantings in the country have been historically higher than early cold plantings (Table A-1). The main reasons have been the organizational difficulties of mobilizing the labor force during the months of August and September, and the difficulties of ensuring an adequate preservation of the soils prepared since April, before the May rainfalls, until the beginning of the so-called cold plantings.

The preservation of the soils, even including their improvement, can be obtained through an agricultural technology of short-cycle crop rotations, the use of pre-emergence herbicides, or a combination of both.

The implementation of a short-cycle crop rotation in extensive planted areas demand, of course, a complex and efficient organizational system in the agricultural sector. Until the end of the 1980 decade, the method of soil preservation for the early cold plantings mostly implemented in the country was the agrochemical; that is, through the use of pre-emergence herbicides.

The possibilities for mobilizing the necessary labor force to fulfill cold planting goals depend on the system of organization and management of the sugarcane agricultural activity, the degree of the bond of the workers to the land, and the efficiency of the system of incentives applied.

Plantings not only impact on yields because of their quality and timing. A very important aspect of the relation planting-agricultural yields, is its stubble replacement capacity. The areas with stubbles with three or more cuttings are one of the factors that increase the crop costs the most. This is due to the careful attention that they demand (weeding, fertilization, irrigation, etc.) and to the decreasing tendency of agricultural yields year after year. As a matter of fact, the stubbles are the canes with highest costs (Acosta Pérez, 1987, p. 7) and lowest agricultural yields (Table 11).

A study conducted in 87 sugar agro-industrial complexes during the harvests between 1978 and 1987, showed that the sugarcane areas are not replaced according to optimization of agricultural and industrial yields (Fernández Carrasco, 1990, p. 8). The amount of planting necessary for stubble replacement depends on a number of factors. These factors include, among others, the physiological status of the cane plant, the decreasing tendency of agricultural

yields due to number of cuttings and cane age, the limiting agro-technical characteristics of the soil, and the economic thresholds of costs and returns (Fernández Carrasco, 1990, p. 8).

The health and vigor of the cane plants in the harvested areas are, therefore, important factors in determining the cane areas to be replaced. In other words, when the management of the plant is deficient, or there are exogenous factors that weaken the cane plant (rust, for example), early replacement becomes necessary.

The Cuban sugarcane experience has shown that the age of cane should not exceed 7.5 years (five or six cuttings), under optimal crop care conditions (Fernández Carrasco, 1990, p. 8). Therefore, a realistic stubble replacement policy that considers the current conditions of the cane population must consider shorter replacement periods and, therefore, higher costs.

Table A-9 shows a comparison between areas harvested whose canes must be replaced and the annual average rate of plantings intended for plantation replacements (to arrive at this indicator one has to subtract from total annual plantings in new areas the total losses experienced in this activity), based on a number of assumptions. They are: under normal management replacement conditions (seven years of age with six cuttings), and, for conditions of six, five, four, and three years of age with five, four, three, and two cuttings, respectively.

In general, as shown by the data in Table A-9, the harvested area that requires replacement grows more rapidly than the average plantings intended to replace plantations in all the cases. In some of the cases, it is obvious that the rate of plantings can not provide the necessities of plantation replacement, which severely affects the levels of existing cane populations and, therefore, the agricultural yields of the crop. In fact, specialists consider the current stubble replacement program in Cuba to be insufficient (Alvarez Dozáguez, 1993, p. 6).

The integrated control of weeds

The implication of the depopulation of cane areas is, without a doubt, the unrestrained growth of weeds. The organizational tasks to ensure an adequate cultural care to the sugarcane crop are of extreme importance for the optimization of its agricultural yields. Table 12 shows some data on the behavior of the indicator "cultural care to the crop" during the 1980 decade.

Table 12. Cultural care practices to the sugarcane crop and benefitted areas in Cuba, 1981-85 and 1986-90.

Item	Period 1981-85	1985-90
	- - - - -million ha- - - - - -	
Fertilization		
balanced	6.747	6.355
nitrogenous	6.975	6.811
Herbicide application	8.671	10.545
Total cultivation	17.361	17.700
Hand weeding	13.258	17.454

Source: MINAZ, Anuario Estadístico (1990, pp. 140-144).

The data presented in Table 12 show a considerable increase of the areas benefitted with activities included in crop care. However, it is estimated that unrestrained weed proliferation is responsible for agricultural yield losses in sugarcane that are above 40% (Alvarez Dozáguez, 1993).

In reality, an efficient organization for an integrated weed control must ensure a systematic care of the sugarcane areas. The non fulfillment, or its fulfillment in an out-of-phase manner, of the seasonal tasks required by the crop could result in large losses in yields and cumulative damages to the plantations.

A theoretical-empirical study has shown that weeds not controlled in time (between 30 and 120 days after planting or harvesting) lowers agricultural yields between 37% and 66% (Alvarez Dozáguez and Acosta Pérez, 1985, p. 1).

In that regard, the crop care activities during the first semester of the year are of utmost priority. It is estimated that, for Cuban sugarcane agriculture, it is necessary to weed and fertilize during the first semester, at the very minimum, around 6.75 million ha of cane in the fields, or 1.35 million ha more than was treated in the years 1986 and 1987 (the two years with highest crops), taking into consideration the different care that the cane fields require in terms of fertilization, hand, chemical, and mechanical weeding (Alvarez Dozáguez, 1993, p. 9).

The integrated weed control program did not become better in the first years of the 1990 decade. In fact, in 1992, the area benefitted from crop care activities during the first semester of the year was only of 2.55 million ha, or less than half the average of the last years of the 1980 decade (Alvarez Dozáguez, 1993).

In summary, the following conclusions can be derived from the previous sections:

The high levels of inputs, investment, and expenditures that characterize an extensive growth model, can not ignore the integrated care that the crop requires. The specific forms of organization and management of the sugarcane agricultural activities have an extraordinary importance in ensuring cane volumes sent to the mill, in the behavior of agricultural and industrial yields, and in the general efficiency of the agro-industrial activity

THE MANAGERIAL AND ORGANIZATIONAL FORM OF SUGARCANE AGRICULTURAL ACTIVITIES DURING THE 1980 DECADE

The Sugar Agroindustrial Complex (CAI) and Its Antecedents

The managerial and organizational form of the sugarcane agricultural activity during the 1980 decade was subordinated to the establishment and development of the sugar agroindustrial complexes. The CAI, as a new form of agroindustrial direction and management, integrated and substituted two forms of management that existed until that time and that had been developed in a relatively independent manner for the sugarcane agricultural sector and for the sugar industry.

In the case of the sugarcane agriculture, the basic cell of management and organization of production had suffered multiple transformations since the initial years of the revolution. For example, once the first Agrarian Reform Law was enacted in May 1959, the state agricultural areas intended for sugarcane production were organized into cooperatives. In 1962, such cooperatives were converted into Sugarcane Farms (*Granjas Cañeras*), or People's Farms (*Granjas del Pueblo*), and, a year later, in 1963, after the enactment of the second Agrarian Reform Law, in State Farms (*Granjas Estatales*).

Several years later, in 1968, as part of a strategy to ensure the necessary sugarcane volumes for the 10-million-ton harvest of 1970, the Sugarcane Plans (*Planes Cañeros*) were created. These plans had the "districts" as their basic cell of direction and organization of production. The districts, that in reality substituted the state farms, began to function as basic productive units tied to a sugarcane collection center.

In a parallel manner, with the establishment of the sugarcane plans in 1969, the so-called Joint Chiefs of Harvests (*Estados Mayores de Zafra, EMZ*) were created at the provincial, regional, and municipal levels. Their objective was to coordinate and direct the harvest in an integrated manner. In 1971, the task of the EMZ was centralized within a new structure (the Sugar Sector) that was responsible for the direction and organization of the sugar

agroindustrial process at all levels.

In 1976, with the implementation of the "New Political and Administrative Division" of the country, and the creation of the "Economic Management and Planning System" (SDPE), the sugarcane districts were transformed into Sugarcane Enterprises (*Empresas Cañeras*), according to the socialist principles of economic calculation, but the districts remained in place as the basic cells of organization and management in sugarcane agriculture (Bazán Reyes and Rivero González, 1985, pp. 23-27).

In 1981, the CAI's first experiences in Cuba took place in the country and, by 1984, all sugar production activities were completely organized in the CAIs.

Theoretically, the CAIs can be defined as economic entities with their own juridical personality, autonomous in the management of their material, labor, and financial resources, and responsible for an efficient execution and fulfillment of the technical-economic plans in an integrated manner (García Marrero and Morales Pita, 1988, p. 38).

The CAI emerged within the general framework of the SPDE and the emphasis on economic viability that had been under development for the Cuban economy since 1975. The CAI, however, assumed a higher level of decentralization and autonomy of the entrepreneurial management than the one existing in Cuba in 1984.

In fact, during the beginning of the 1980 decade Cuba was applying a restricted version of the economic calculation (defined later) at the national economic level (limited autonomy of the enterprises, centralized planning, restrictions in the creation of incentives funds, etc.). The CAI, however, because it was the unit of two different productive processes (one agricultural and the other industrial), from whose efficient management depended the production of the complex and the incentives to workers, impelled by its mere existence to the application of a more complex system of economic calculation: the so-called internal economic calculation.

The internal economic calculation constitutes the application of the principles of economic calculation to the respective subdivisions of the complex: branches, brigades, shops, departments, etc., which implies the existence of similar levels of efficiency, or at least compatible, of the subdivisions that form the complex, a high technological-organizational level in all its parts, an efficient level of planning at the global and departmental level, and an effective and sophisticated system of incentives.

For those reasons, since their establishment, the CAIs showed their incompatibility with what in 1984 constituted the

organizational and directional cell of sugarcane agriculture at that time: the district.

Main Characteristics of the Incentives System

The incentive system was an unmanageable problem of all the organizational and managerial schemes implemented in sugarcane agriculture during the last decade. By definition, a system of incentives under economic calculation must ensure a coherence between the individual and collective interests in order to reach efficient productive results (MINAZ, 1993a, p. 1).

In the case of sugarcane agriculture, the objective was the designing of an incentive system capable of ensuring the necessary cane volumes during the harvests, and an increase in agricultural yields.

In the experimental CAIs, an incentive system based on monetary premiums related to a group of indicators was established in 1981. The indicators intended to measure four essential aspects: (a) the fulfillment of the periodical technical-economic plans (monthly, by-trimester, bi-annual, and annual); (b) cane volumes delivered in the harvest; (c) behavior of agricultural yields; and (d) level of cane population in the agricultural areas.

According to the system of incentives based on premiums, when the unit fulfilled the goals, the maximum amount of premiums to be received by an agricultural worker could not exceed 30% of his/her basic salary earned during the period considered by the specific indicator. Such percentage was broken down following three concepts: (a) 10% for fulfillment of the monthly plan for agricultural activities; (b) 20% for the level of cane population in agricultural areas; and (c) 10% for the fulfillment of the agricultural yield levels specified in the plan.

This system of incentives through premiums was extended to the CAIs in 1984 and, because of its insufficiencies, was only in place until 1985. The main insufficiencies of such system were the following: (a) agricultural yields could not achieve their potential levels; (b) it resulted in serious inefficiencies in the planning process (i.e., planned goals were sometimes relatively easy to fulfill to ensure their over-fulfillment); (c) it generated inflationary pressures through the printing of money lacking productive backup (MINAZ, 1993a, pp. 10-22).

This system of incentives applied to sugarcane agriculture developed into a crisis during 1985. In fact, the district, as the organizational and directional cell of the sector, was becoming a very restrictive and bureaucratic framework for the autonomous management of the CAI. In fact, under the organizational conditions of the district, the method of direction employed were essentially administrative and were instrumented through rules and regulations,

resolutions, methodological directives, and instructions of compulsory fulfillment for the district and its elemental units of production: the sugarcane production fields.[5]

That is, in the organizational contradictions of the district, the board of directors, composed by the district chief and the chiefs of irrigation, machinery, agrotechnic, human resources, economics, and securing, were in practice a hierarchical link in charge of controlling and applying the norms centrally developed and of compulsory fulfillment to the CAI, the district, and the elemental units of production (cane blocks). Under such conditions, the technical-economic plan was no more than a technological primer to which a system of incentives based on premiums was added.

A new form of management and direction was introduced in sugarcane agriculture in 1985. They were called the "Permanent Production Brigades" (*Brigadas Permanentes de Producción*), or BPP. The BPPs assumed a more autonomous form of direction, in correspondence with the principles of internal economic calculation. They also implied a higher use of the economic direction methods in order to fulfill the periodical technical-economic plans.[6]

In 1987, the system of incentives to the BPP based on premiums was stopped. In fact, the SDPE was subjected to strong criticism by the country's leadership during that year, including a global critique and, above all, a critique about its inherent system of management and incentives (Castro Ruz, 1987).

The system of incentives applied to the BPP, in particular, was critiziced for the following insufficiencies:

(a) It could not eliminate the inflationary pressures; that is, the tendency to grant premiums that were not justified by production volumes was also in place under the incentive system designed for the BPPs.

(b) Its implementation was extremely cumbersome. For example, the BPP's technical-economic plan was subject to numerous changes during the calendar year depending on the cultural activities and

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[5]The sugarcane block represents the basic unit of area for the planning, execution, and control of the agro-technical and harvesting activities (MINAZ, 1990, p. 5). Its size depends on the irrigation system used: 98.96 ha on dry lands; 96.14 ha in gravity; 93.8 ha in sprinkling; 293.2 ha with frontal machines; and 98.6 ha with pivotal machines.

[6]For a full description on the operation of the incentives system under the conditions of the BPP, see MINAZ (1993a, pp. 10-22).

the starting and ending of the harvest --aspects which impacted directly on the estimation of the value of gross production and, therefore, on the system of incentives.

(c) It had no relevant impact on agricultural yield increases or on the systematic increases of cane volumes during the harvest.

(d) It did not achieve a correspondence between expenditures and production, which lessened the value of the indicators used to measure relative savings in inputs and labor force.

(e) It became extremely cumbersome for the workers who were, in short, the target of the incentives system.

Once the system of incentives based on premiums was dismantled in the BPPs, a series of experiments were conducted throughout the 1988-92 period. The objective was to find a system of incentives applicable to sugarcane agriculture to address three main issues: (a) ensuring the volumes of cane for the harvest; (b) increasing agricultural yields; and (c) increasing cane population in agricultural areas.

Of the different experiments conducted, the most important one was that carried out in the CAI Osvaldo Sánchez, in the province of Habana, during the 1989-90 season. It was derived from the experiences of the Agricultural Production Cooperatives (CPA).

This one-year experiment was based on two concepts: (a) the application of a scale of differential prices to the volumes of cane delivered according to actual agricultural yields; and (b) the distribution of a percentage ranging from 50 to 70% of the net returns obtained (difference between the value of production and expenditures) as an incentive. The scale of differential prices provided a price incentive for production if yields were higher than 50.4 mt/ha, following a special break-down (Table 13).

Table 13. Agricultural yields and internal prices for sugarcane in Cuba.

Yield	Price
mt/ha	Pesos/1000 kg
Up to 50.4	11.46
Between 50.4 and 58.8	11.90
Between 58.8 and 67.2	12.34
Between 67.2 and 75.6	12.79
Between 75.6 and 84.0	13.00
More than 84.0	13.23

Source: MINAZ (1993a, p. 12).

The experience left positive results. For example, average agricultural yields in this CAI increased from below 50.4 mt/ha in 1987, to 58.8 mt/ha in the 1989-90 and 1990-91 seasons. There was also a reduction of total costs of 1.09 pesos per 1,000 kg (MINAZ, 1993a).

In 1992, the basic cell of organization and direction in sugarcane agriculture (the BPP) was again transformed, adopting the old name of "sugarcane farms" (*granjas cañeras*).

Concerning direction as such, the differences between the BPP and the sugarcane farm were not very relevant, although the latter was granted more autonomy (MINAZ, 1993a). The innovation of the "new" organizational cell was its incentives system that was, precisely, the one tried at CAI Osvaldo Sánchez. However, the new incentives system based on a scale of differential prices according to yields, and through the distribution of net returns, was not extended to all the CAIs throughout 1992. In fact, it was at that time that the country's leadership was analyzing a new form of organization and management applicable to all agricultural activities.

Starting in the second semester of 1993, a new form of organization and management was beginning to be implemented in sugarcane agriculture: the Basic Unit of Cooperative Production (*Unidad Básica de Producción Cooperativa, UBPC*).

STATUS OF SUGARCANE AGRICULTURE DURING THE 1990-93 PERIOD

All main indicators of sugarcane agriculture and industry have been rapidly deteriorating in the last few years (Table 14 and Fig. 3). In fact, the demise of socialism in the Eastern European countries, and of the Council for Mutual Economic Assistance (CMEA), represented the elimination of the main framework within which Cuba's economic relations were taking place. As a matter of fact, at the end of the 1980 decade, Cuba was conducting around 81% of its external commercial relations with the member countries of CMEA. This group of countries was taking the main volume of Cuba's total exports (63% of sugar, 73% of nickel, 95% of citrus), and was the origin of around 85% of Cuba's total imports that included 63% of food, 86% of raw materials, 98% of fuels and lubricants, 80% of machinery and equipment, and 57% of chemical products (Alvarez González and Fernández Mayo, 1992, pp. 4-5). Furthermore, the trade relations between Cuba and the CMEA took place under favorable conditions for the Cuban economy. For example, it has been estimated that, during the 1981-90 period, Cuba had incomes about 50% higher to those that would had been obtained at world market prices (Alvarez González and Fernández Mayo, 1992, p. 4).

The direct impact that the demise of socialism in the above-mentioned countries and the CMEA had on the Cuban economy becomes more obvious when analyzing Cuban imports statistics for 1989 and

Table 14. Main indicators of the sugar agroindustry in Cuba, 1987-93.

Year	General Indicators			
	Production		Yield	
	Sugar	Cane	Industrial	Agricultural
	million mt	million mt	Percent	mt/ha
1988	7.42	67.5	10.85	51.7
1989	8.12	73.9	10.83	54.5
1990	8.04	74.4	10.65	52.0
1991	7.62	71.0	10.59	49.1
1992	7.01	65.4	10.57	44.7
1993	4.30	42.9	9.85	35.3

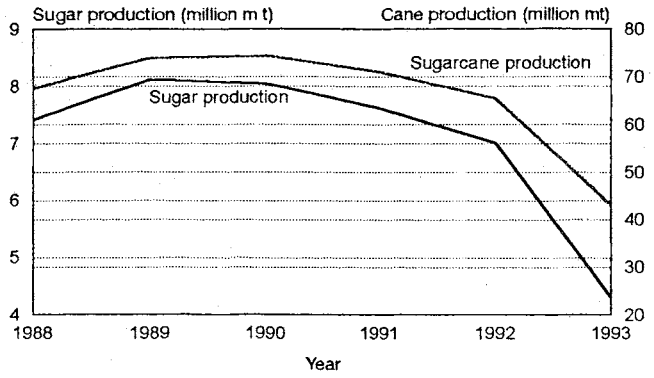
Year	Sugarcane areas		
	With cane on Dec. 31	Harvested[a]	Planted
	1000 ha		
1987	1,829	1,366	397
1988	1,759	1,305	337
1989	1,800	1,355	360
1990	1,774	1,427	289
1991	1,720	1,443	217
1992	1,702	1,461	263
1993	1,600	1,219	NA

	Cultural activities				
	Area fertilized		Area	Weeding	
	Balanced	Nitrogen	Cultivated	Hand	Herbic.
	1000 ha				
1987	1,291	1,156	4,373	3,222	2,042
1988	1,197	1,246	3,406	3,899	1,837
1989	1,231	1,394	3,484	4,026	2,204
1990	1,204	1,361	1,677	3,483	2,395
1991	508	922	949	3,286	2,433
1992	27	790	1,245	2,944	1,648

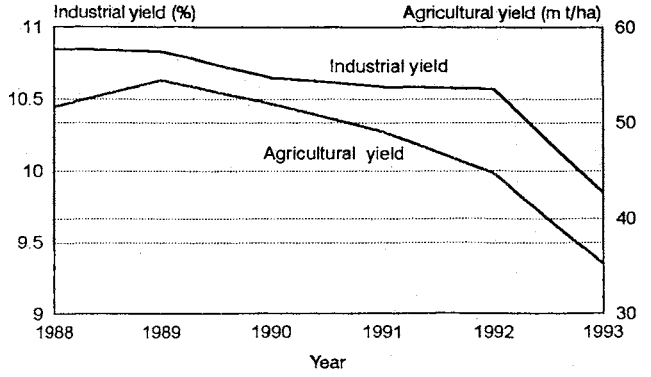
NA = Not available.

[a]Encompasses the harvest seasons 1986-87 through 1992-93.

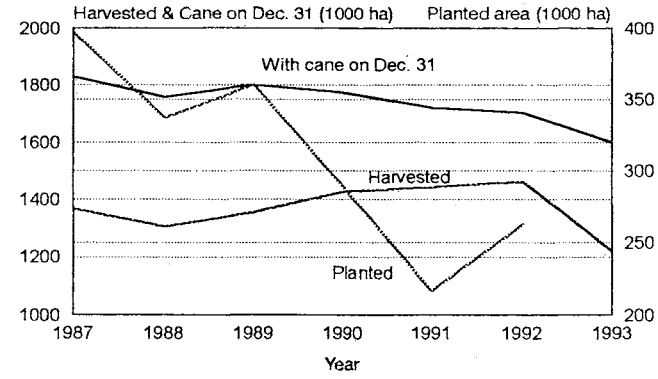
Source: Sulroca (1994).



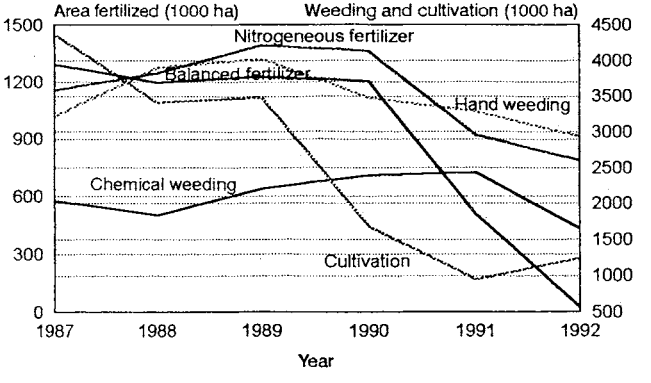
(a) Sugarcane and sugar production, 1988-93.



(b) Agricultural and industrial yields, 1988-93.



(c) Sugarcane areas planted, harvested, and with cane on December 31, 1987-93.



(d) Fertilization, cultivation, and weeding activities, 1989-92.

Fig. 3. Main indicators of the sugar agroindustry in Cuba, 1987-93.

1992. In 1989 Cuban imports exceeded 8 billion pesos, while in 1992 the figure was 2 billion pesos for a decrease in value of more than 70% in only three years (Alvarez González and Fernández Mayo, 1992, p. 8).

A reduction of such magnitude necessarily and severely impacts the economic and social activity of the country. In the case of sugarcane agriculture, the inputs and type of equipment experiencing the most severe restrictions due to the fall in imports are: potassium chloride, ammonia, herbicides, potassium sulfate, ammonium sulfate, triple superphosphate, urea, cane loaders, irrigation motors, agricultural tools, towing equipment, crawler tractors and with rubber tires, etc., in addition to fuel and lubricants, spare parts, and many others that also impact on the whole economy.

As stated above, the value of agricultural imports of inputs and equipments between 1989 and 1992 was reduced by more than 70% by value (MINCEX). This has become a serious constraint for the development of one of Cuba's priority sectors: the sugarcane sector.

Fig. 3 depicts that situation in a dramatic manner. Sugarcane and sugar production have fallen dramatically since 1989 (Fig. 3(a)), with a further decrease (to 4.0 million mt) in 1994, and an already projected even lower sugar output for 1995. Agricultural and industrial yields have also experienced drastic decreases (Fig. 3(b)), as well as sugarcane areas (Fig. 3(c)). Important cultural practices have also followed similar trends (Fig. 3(d)).

The most severe problem that Cuban sugarcane agriculture is facing today is the depopulation of cane areas. Table 14 shows that, in only five years, sugarcane areas diminished by 10% and harvested areas by 15%. This depopulation in not only obvious from a diminishing number of available areas. The sharp decrease in agricultural yields under conditions of decreasing harvested areas (30% in only three years), is a clear sign of the decreasing and weakening of existing plantations. In that regard, it is conservatively estimated that, at present, 30% of the areas under cultivation are depopulated (Alvarez Dozáguez, 1993, p. 6).

The depopulation of sugarcane areas is the main reason for the decrease in cane volumes delivered to the industry. In fact, between 1990 and 1993, cane harvested decreased by almost 50%, or from 75 to 42 million metric tons. The weakening of the plantations also surfaced in the quality of the sugarcane harvested. Data on industrial yields show a 1% decrease between 1988 and 1993, which translates into considerable losses in pol levels.

Two main reasons account for the situation just described: (a) the deficient integrated care to the crop just explained (this problem is inherent to the state extensive growth model and to the

forms of organization and management that were in place in the Cuban sugarcane agriculture for more than twenty years); and (b) the impact (a reduction of more than 70% in Cuba's import capacity) that the demise of the socialist system in Eastern European countries and the former Soviet Union had on the Cuban economy.

A NEW FORM OF ORGANIZATION AND MANAGEMENT IN SUGARCANE AGRICULTURE: THE BASIC UNIT OF COOPERATIVE PRODUCTION (UBPC)

Law-Decree No. 142 of 20 September 1993 established the so-called Basic Units of Cooperative Production in pursuit of the following goals: (a) to achieve a closer relationship between man and working place; (b) to channel the cooperative efforts of the workers and their families in the improvement of the living conditions of the collective, including self-sufficiency; (c) to closely and rigorously relate workers' earnings to the production achieved; and (d) to develop the autonomy of management of the collective on their resources with the objective of achieving self-sufficiency in the productive process (MINAZ, 1993b, p. 3).

Article 2 of such Law-Decree established the following:

> The Basic Units of Cooperative Production will have their own juridical personality, and will function under the following main characteristics:
> (a) will have the usufruct of the land for an indefinite time;
> (b) will be the owners of production;
> (c) will sell their production to the State through the enterprise or in the manner that it decides;
> (d) will pay the insurance premiums;
> (e) will manage bank accounts;
> (f) will purchase the fundamental means of production on credit;
> (g) will collectively elect its leadership and it will periodically render accounts to its members; and
> (h) will fulfill the corresponding fiscal responsibilities as their contribution to the general expenditures of the Nation (MINAZ, 1993b, p. 4).

Related to Law-Decree 142, the Ministry of the Sugar Industry enacted its Resolution No. 160-93 eight days later, which contained the "General By-Laws of the Basic Units of Cooperative Production in Care of MINAZ" (MINAZ, 1993b, p. 6).

Under Articles 1, 2, and 3 of Chapter I, Generalities, the following was established:

(a) The UBPCs are part of the production system of a Sugar Agroindustrial Complex (CAI), constituting one of its primary links.

(b) The UBPCs are directly related to the CAI without intermediate organizations, are the owners of the production and of the basic means they purchase on credit, sell their production to the CAI, and have management autonomy over their productive and monetary resources.

(c) The UBPCs are fundamentally established with the sugarcane farmers that are related through work to the lands meant for the UBPC, and that voluntarily express their wish to belong to this new form of sugarcane organization (MINAZ, 1993b, pp. 9-10).

Concerning the economic framework of the sugarcane UBPCs, and the remuneration to the collective and to the individual worker, the By-Laws expressed the following in its Articles 30, 32, 34, 36, and 37, of Chapter IV Economic Framework:

(a) The first priority of the UBPC is to work for the development and increase of sugarcane production with a higher sucrose content. The UBPC can affect the areas devoted to sugarcane only when exceptional circumstances so dictate and with prior approval of the MINAZ Territorial Delegate.

(b) In all UBPCs, once the economic cycle is finished, and with prior estimation of total revenues, payments will be made for: assets acquired at the time of its establishment, fulfillment of the responsibilities acquired by receiving loans, taxes, and other expenditures generated during the productive process.

Once the remaining total balance is determined, up to 50% of such balance can be distributed among the members, and the rest must go into a reserve fund for its utilization in the following areas: contingencies, acquisition of basic and rotational means, house buildings, construction of productive and social installations, incentives, and others, with prior approval of the General Membership Assembly.

(c) The remuneration to each member depends on the quantity and quality of the work performed and on the economic result of the UBPC. To that effect, each member receives a periodic cash advance equivalent to the fulfillment of the work norms. At the end of the economic year, he/she receives part of the profits, which are distributed according to the work performed.

(d) The hiring of seasonal workers by the UBPC, and with the funds it autonomously administers, is allowed (MINAZ, 1993b, pp. 20-21).

The Board of Directors of each UBPC is composed of nine members: the Manager, the Chiefs of Economics, Production, Services, Machinery, Parcels, the Principal Engineer, and two other UBPC members.

The similarities between the Agricultural Production Cooperatives (CPA) and the UBPC are obvious. As a matter of fact, the economic frameworks, as well as the means of collective and individual remunerations, are very similar. The only exception, of course, is land ownership in legal terms since the CPA is the owner of its land while the UBPC receives the land in usufruct from the state for an indefinite period of time.

In fact, the UBPCs are based on the experiences of the CPAs, whose economic performance was, in general, more efficient than the state farms throughout the 1980 decade. Alvarez and Puerta (1994, Table 3) have shown that nonstate farms (CPAs plus independent farmers), even with a dramatic disparity in their access to inputs when compared to state farms, have performed better than state farms in each of the last twenty-one seasons (*zafras*) for which data are available."[7]

At the end of that decade, the CPAs were working approximately 12% of the land devoted to sugarcane production and were harvesting around 18% of the sugarcane delivered to the harvest (CEE, Anuario Estadístico de Cuba, 1989, p. 118). Some interesting data on selected indicators of the CPAs in sugarcane agriculture for the 1981-85 and 1986-90 periods are available (Table 15).

Table 15. Selected indicators of the CPAs in Cuba's sugarcane agriculture, 1981-85 and 1986-90.

Indicator	Unit	Year or Period				
		1981-85	1988	1989	1990	1986-90
Yield	mt/ha	57.5	56.9	57.9	59.0	55.4
Production	1000 mt	26.1	5.1	5.4	5.5	25.7
mechanized	percent	27.9	45.2	46.9	59.7	47.7
No. of CPA	#	414.0	423.0	406.0	402.0	459.0
Coop members	1000	27.8	28.4	27.9	27.7	28.7
Gross area	1000 ha	--	328.0	322.6	310.5	--
Net area	1000 ha	--	292.9	290.2	279.4	--

Source: MINAZ, Anuario Estadístico (1990, p. 192).

[7]Based on prior observations by Fry (1988) and his own research, Pérez-López (1991, pp. 31-32) argues that yield differences are much less significant when the data are examined at the provincial level. Alvarez and Puerta (1994), however, have noted that "although his analysis of the three *zafras* in the provinces of La Habana, Matanzas, and Villa Clara (where yields tend to be highest and where nonstate farmers tend to be concentrated) seem to support that assertion, nonstate yields in those provinces are still higher than state yields on the average and much higher in the remaining 10 provinces" (en. 11, p. 1674).

Once the establishment of the UBPCs in sugarcane agriculture was approved, an accelerated changing process took place in the sector. By the end of 1993, less than three months later, practically all state lands devoted to sugarcane production was reorganized under this new form of management and direction, and more than 98% of the cane agricultural workers became cooperative members (Table A-10).

The conversion of state farms into UBPC not only was a structural change but also meant a transformation of land distribution from the standpoints of growing, producing, and managing the cane.

At the beginning of 1993, there were approximately 734 sugarcane state farms with a gross cane area of 1.3 million ha and a net area of 1.2 million ha. Under such circumstances, the average agricultural area per state farm was 1825 ha, 1665 of which were specifically devoted to sugarcane. In December 1993, 1.2 million ha of the total state agricultural area, approximately 93%, was converted to the new organizational form that, by that time, reached 1556 UBPCs. The figures translated into an average agricultural area of about 799 ha per UBPC (a reduction of 56% in relation to the area under control by the state farm), of which, and on the average, 710 were devoted to sugarcane (MINAZ, 1994).

In real terms, by the end of 1993, the land distribution in the UBPCs was as follows (Table A-10):

> 540 ha	15%
541 - 810 ha	37%
811 - 1080 ha	22%
1081 - 1350 ha	11%
>1350 ha	15%

The UBPCs have an average of 11.42 ha per worker, while the remaining state farms in sugarcane have almost 30 ha/worker.

It is still early for evaluating the effectiveness of the UBPCs. Nevertheless, it is important to keep in mind that they developed in a particularly critical moment for both the sugarcane sector and the Cuban economy as a whole. For that reason, spectacular results in the short-run should not be expected.

There exists, at present time, an internal debate in Cuba about the UBPCs, their structural, economic, and productive improvement, their degree of autonomy, their incentive mechanisms, their relationship with the CAI, and many others. For example, the debate includes the pricing mechanism that will be applied to sugarcane production during the next 1994-95 harvest to stimulate agricultural yields. In reality, a proposal has been put forward to apply a system similar to the one in the CPAs, based on a differential price system according to yields, as explained above

(MINAZ, 1994).

The most contentious debate relates to the degree of autonomy of the UBPC from the CAI, the relationship of the cooperatives with suppliers and with other coops and state enterprises, etc. There is a general consensus among UBPC, CAI, and MINAZ, of the need to improve the mechanisms of autonomous management in the UBPC, such that these could exert, in practice, a greater control of their resources according to their collective interest and in correspondence with the objectives for which they were established; that is, the sustained development of sugarcane agriculture (MINAZ, 1994).

The process of the UBPC's improvement is still in its infancy, and it is possible that their development will be slow and long.[8] But the UBPCs are already a transcendental fact. The UBPCs are a new modality of organization and management in both sugarcane agriculture and Cuban agriculture in general, implemented within an extremely complex economic framework, both in terms of the global potential of the country's economy and the external context within which it has to function. In that regard, the UBPC is a necessary alternative to the new conditions facing the Cuban economy but they are also an irreversible alternative.

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[8]However, since the very beginning (and a very important signal), they have been guided by the concept of economic efficiency in most activities. The authors were able to confirm it during their visit to the sugarcane UBPC "Antonio Maceo" in the Bauta municipality, La Habana province, in August 1944. Economic efficiency criteria have guided coop members at the time of (a) selecting machinery, equipment, and personnel from the former state farm; (b) making decisions about input purchases; (c) performing different cultural practices; (d) restructuring the bureaucratic apparatus of the coop; and in many other instances.

FLORIDA'S SUGAR INDUSTRY

MAIN CHARACTERISTICS OF FLORIDA SUGARCANE AGRICULTURE DURING THE 1980-93 PERIOD

The Production Area

The Florida sugar industry is concentrated around the southern shore of Lake Okeechobee, primarily in Palm Beach County (Fig. 2). Most sugarcane production in Florida takes place in the Everglades Agricultural Area (EAA). The EAA is an economically important and sensitive environmental area. It encompasses 650,000 acres of the upper Everglades, extending from Lake Okeechobee south to the Broward county line. Most of the soils in the EAA are organic (Histosols), generally containing 85% or more organic matter by weight (Snyder et al., 1978).

In addition to sugarcane, other crops include winter vegetables, sod, and rice. Although the organic soils generally do not require nitrogen fertilization, great quantities of phosphorus (P) and potassium (K) must be applied to these crops.

A great amount of attention has been focused on the EAA in recent years. It stems from concern over the environmental health of Lake Okeechobee (one of the main suppliers of water for southern Florida), the Water Conservation Areas, and the Everglades National Park.

Another source of concern is the oxidation of the organic soils. The process, called "subsidence", has been present since the area was first drained for agricultural production. The rate of subsidence has been estimated at one inch per year (Snyder et al., 1978).

Number of Growers, Land Tenure, and Organizational Forms

Barry et al. (1990, p. 8) reported 121 sugarcane growers in 1988, while Buzzanell et al. (1992, p. 16) reported 133 in 1990. Member growers in a cooperative mill account for less than half. There are a few large corporations. The remaining growers own medium to small operations.

Examining public records of land ownership provides some insights on the structure of the sugarcane industry (Table 16 and Fig. 4). However, (a) a land owner does not always equal a sugarcane grower; (b) most of the owners of small acreage either rent their land to larger owners or enter into some type of agreement with a farm manager; and (c) although about 58% of the land in sugarcane is owned by four firms and 83% of the land is owned by 15 firms, one company may own and operate more than one firm; that is, there are more farms than producers.

Table 16. Distribution of land ownership in Florida's sugarcane acreage, 1991.

Range of Acres	Number of landowners	Percent of all landowners	Total acres	Percent of total acres
Greater than 20,000	4	1%	268,200	58%
10,001 to 20,000	5	2%	68,400	15%
5,001 to 10,000	6	2%	46,800	10%
641 to 5,000	40	12%	52,305	11%
321 to 640	39	12%	14,535	3%
101 to 320	42	13%	4,767	1%
2 to 100	96	29%	1,634	0%
Less than 1	98	30%	15	0%
TOTAL	330	100%	456,641	100%

Sources: Hazen and Sawyer (1992, p. 2.6), as taken from Palm Beach County Property Appraiser's Computer Tape Files and Hendry County Property Appraiser's Files.

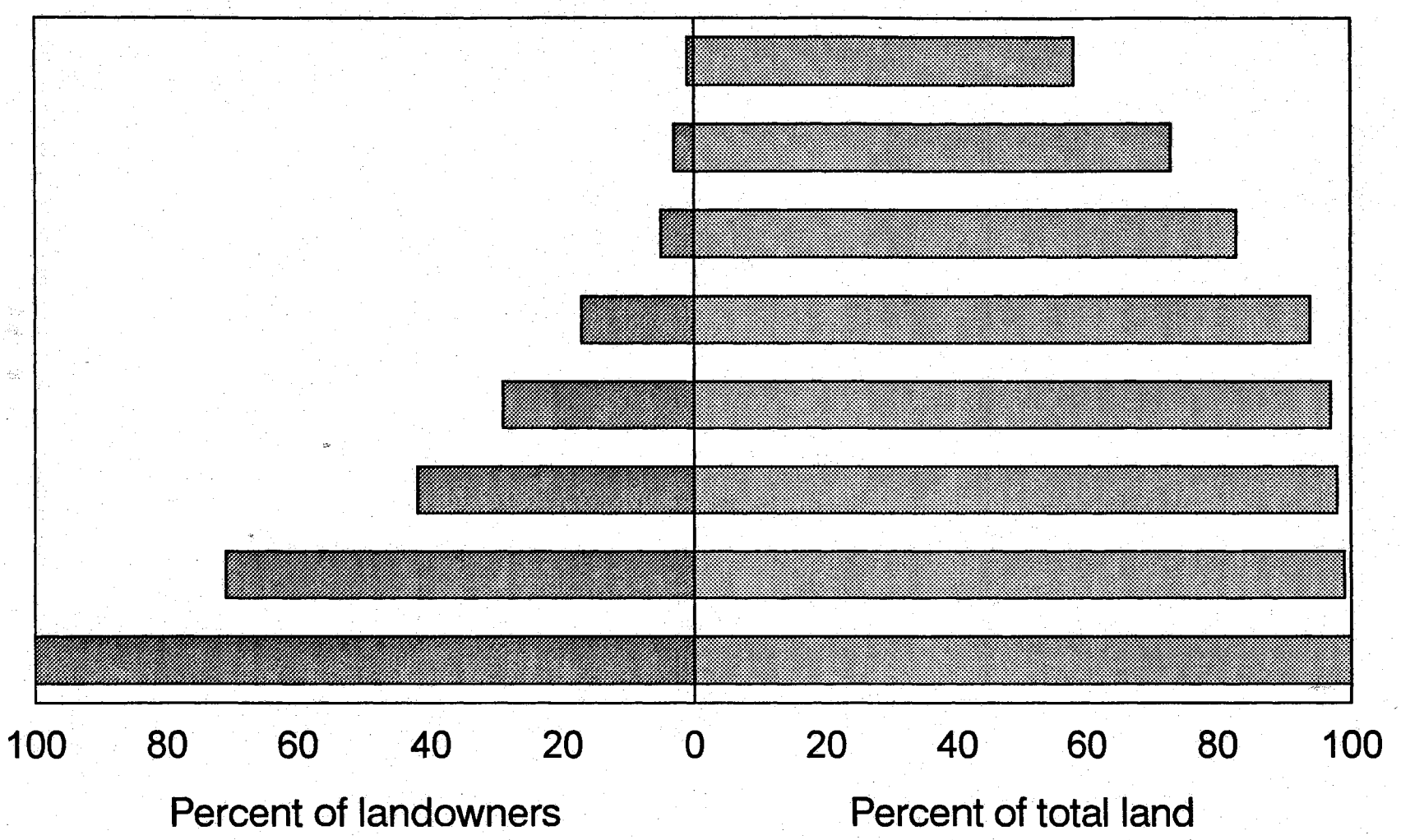

Fig. 4. Distribution of land ownership in Florida's sugarcane acreage, 1991.

There are two types of organizational forms in the industry. Sugarcane grown either by a corporation for use in its own mill or by a cooperative member for use in the cooperative mill is referred to as "administration cane." Cane grown by an independent producer is referred to as "independent cane."

Most of today's industry is vertically integrated but independent growers and one grower-owned cooperative produce some of the output. There are seven raw sugar mills with an average daily processing capacity of about 14,400 short tons for a total of 101,000 short tons. Six of these mills are owned by individual parties and one is cooperatively-owned by growers. There are also two refineries; one is independent and the other belongs to a corporation also involved in raw sugar production.

Although approximately 300,000 tons of sugar have been refined in the State, Florida sugar is mostly marketed through the Florida Sugar Marketing and Terminal Association, established by five of the seven raw sugar processors, and with storage and port facilities in the Port of Palm Beach (Fig. 2). Some sugar is also marketed through long-term contracts with sugar refineries located outside the State (Buzzanell et al., 1992, p. 18).

Agricultural Inputs

Although with some variations, which depend on a number of factors such as distance from Lake Okeechobee, year of crop cycle, and method of harvesting, among others, sugarcane production practices in Florida are rather homogeneous. The current enterprise budget (Alvarez and Schueneman, 1991) assumes a 640-acre (usually referred to as "one section" or the area within one square mile) farm operated by an independent grower. Farms in the EAA are broken down by sections for management decisions. The land use and corresponding yields are shown in Alvarez and Schueneman's Table 1 (p. 4), while Table 2 (p. 6) contains the list of machinery and equipment necessary to operate the farm.

Inputs required to perform preharvest cultural practices (land preparation, planting, and cultivation) on plant cane are shown in Table 3 (p. 8), while Table 4 (p. 10) describes those related to ratoon cane. Finally, overhead and harvesting activities appear in Table 6 (p. 15).

In general, most inputs are available within the producing area. In addition, custom hiring services are also available for those producers who lack the necessary machinery and/or equipment to perform a variety of tasks.

Acreage, Yields, and Total Production

Industry acreage continued to expand during the 1980-93 period from 320,700 in the 1980-81 season to a preliminary estimate of

425,000 acres in the 1993-94 campaign (Table 17). Most of the expansion has taken place in marginal muck soils and in sand lands adjacent to the EAA, where about 13% of the cane acreage is now located. Some of the increased planted acreage is also due to successive planting --a practice designed to eliminate the fallow period since sugarcane is replanted shortly after harvest. However, a recent study concluded that further expansion, due mainly to lack of available land close to the mills, is not expected (Advincula et al., 1992).

The rather small ups and downs in yields is somewhat misleading (Table 17). Although yields have apparently remained constant during the 14-year study period, it has been recognized that the industry expansion to marginal lands, and the lower yields obtained with successive planting, have constrained higher average productivity figures. It has been stated that "maintaining the same yield level on less productive Florida lands is a clear sign that new variety releases have resulted in more sugarcane production" (Alvarez and Polopolus, 1991a, p. 14).

Total production figures mirror both acreage and yields (Table 17). Small acreage expansions and slightly higher yields have resulted in total productions of close to 15 million short tons in the last years of the study period.

Costs of Production[9]

The costs of production practices previously described allow the computation of total cost figures. Assuming a price per standard ton of $25.88 (22.5 cents per pound of sugar times the fair price determination factor of 1.15), and a price of molasses of $0.38 per gallon, provide total revenue figures. From both cost and revenue figures, gross and net margins are calculated (Table A-11). The analysis concludes with the computation of returns to the various factors of production per gross acre (Table A-12).

The previous results allow the calculation of costs and returns for the different units of production. Dividing total costs and total net returns by the corresponding unit measures provides the following results:

	Total cost ($)	Net return ($)
Gross acre	822.90	237.81
Net acre	1,001.87	269.85
Harvested acre	1,169.89	315.11
Gross ton	25.76	6.94
Net ton	27.12	7.30
Standard ton	21.89	5.89

[9]See fn. 2.

Table 17. Acreage, yields, and total production of sugarcane in Florida, 1980-81 through 1993-94.

Crop year	Area harvested	Yield per acre	Total production
	Acres	Short tons	1,000 short tons
1980-81	320,700	31.1	9,985
1981-82	334,400	28.5	9,530
1982-83	341,400	35.4	12,086
1983-84	361,100	31.4	11,330
1984-85	371,900	32.5	12,087
1985-86	383,400	32.9	12,615
1986-87	390,000	33.1	12,916
1987-88	402,000	32.3	12,990
1988-89	404,000	31.6	12,766
1989-90	405,000	31.4	12,717
1990-91	419,000	35.5	14,874
1991-92	428,000	34.9	14,937
1992-93	426,000	33.2	14,143
1993-94[a]	425,000	34.1	14,512

[a]Preliminary.

Source: Economic Research Service (June 1994, p. 50).

Estimates for individual farms in the area would fluctuate from the representative farm due to factors varying from the assumptions made. Among these factors, yields (particularly sucrose), years in crop cycle, method of harvesting, and farm ownership structure (corporate or cooperative instead of independent cane), are the most important ones. Needless to say, some economies of scale are present in larger operations.

THE U.S. SUGAR PROGRAM[10]

Sugar is one of the commodities protected in the U.S. Farm Bill, which also includes rice, cotton, dairy, tobacco, peanuts, and other grains such as wheat, corn, and soybeans. Some are supported through loan programs, target prices, and deficiency payments along with export enhancement programs or through marketing loans and acreage restrictions. Others have loan programs or guaranteed minimum prices without production or acreage controls.

The sugar program is an example of the latter. It consists of a loan program and a market stabilization price (MSP), and, until recently, without production or acreage controls. The loan rate is the legislated price per pound at which processors can obtain financing from the government by committing raw cane sugar as collateral. The MSP is determined as the sum of the loan rate plus interest charged on the loan, a freight charge, and a small marketing incentive. Until recently, there were no acreage or production restraints. Import quotas and tariffs were the main policy instruments utilized to comply with the provision that the program has to operate at no cost to the federal government as they can be reduced in times of excess supplies or increased when supplies are short and sugar prices surpass the MSP's objective.

The current Farm Bill was signed into law in November 1990. It is called The Food, Agriculture, Conservation and Trade Act of 1990. It also has a sugar program which became effective October 1, 1991 and covers the 1991 through 1996 sugar crops.

Most of the provisions of previous Acts remained unchanged but others were added. The loan program remained the same. Despite efforts to reduce the loan rate, the minimum loan rate remained frozen at 18 cents per pound for the life of the Act. The MSP remained at the level of 21.95 cents per pound set for the 1989-90 crop in the following manner:

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[10]Some of the information on the Sugar Program and the Farm Bill appeared in Alvarez and Polopolus (1990b; 1991b).

Loan rate:	18.00	cents per pound.
Freight charge:	3.04	cents per pound.
Interest:	0.71	cents per pound.
Incentive factor:	0.20	cents per pound.
Total MSP	21.95	cents per pound.

Other provisions included:

(a) import quotas: a minimum import quota of 1.25 million short tons, raw value, was established, as well as marketing controls on domestic sugar, if imports are projected to fall below the 1.25 million ton target;[11]

(b) re-export program: a new re-export program was designed as the result of the implementation of the new sugar import system previously described: raw sugar imported under the re-export program can not fall within the import amount authorized under the minimum tariff of 0.625 cents, and the sugar has to come from countries holding U.S. quotas;

(c) Program service fee: a program service fee was imposed; and

(d) marketing controls: marketing allotments can be imposed upon sugarcane and sugarbeet processors and also upon manufacturers of crystalline fructose from corn if the Secretary of Agriculture determines that foreign imports are projected to be less than 1.25 million short tons.[12]

The decision to trigger marketing allotments is based on the statutory Marketing Allotment Import Estimate (MAIE) formula. If

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[11]This mechanism is in agreement with the implementation on October 1, 1990, of a two-tiered tariff scheme designed to satisfy GATT's ruling that the U.S. sugar quotas were illegal under international trade law. The first step of the new program consists of 0.625 cents per pound for foreign imports up to 1.725 million short tons of raw sugar. The second step involves no sugar quotas for imports in excess of 1.725 million short tons. However, a tariff of 16 cents per pound will be imposed on all sugar imports exceeding 1.725 million short tons.

[12]On June 30, 1993, the U.S. Department of Agriculture announced preliminary marketing allotments for sugar and crystalline fructose for fiscal year 1993 (Oct. 1991-Sept. 1993). The overall allotment quantity was based on domestic marketing (including Puerto Rico) totalling 7.77 million short tons --4.15 million for beet sugar and 3.62 million for cane sugar. Florida processors received 1.702 million of this allocation which was later increased to 1.925 million short tons of raw sugar (Economic Research Service, September 1993, pp. 17, 19).

Consumption (C) + Reasonable Ending Stocks (RES) - Beginning Stocks (BS) - Production (P) results in an MAIE of less than 1.25 million short tons, allotments would be triggered. The key program decision is the determination of RES. Rearranging the MAIE formula, allotments would be imposed if RES < 1.25 + P + BS - C (Economic Research Service, June 1994, p. 14).

METHOD OF PAYMENT TO PRODUCERS[13]

Florida sugarcane producers operate under the provisions of the sugar program contained in the Farm Bill. Of primary interest to this study is the method of payment for the sugarcane produced. The method described, although originated in the Sugar Act which expired at the end of 1974, is still used for Florida independent growers and members of the cooperative mill.

When the grower delivers sugarcane to a mill, the cane is weighed. A standard percentage deduction is taken from gross weight as an allowance for "trash" delivered with the cane. The result is the "net weight," which is measured in tons, hence giving rise to the unit of measurement "net tons". The sugarcane clear of trash is called "net sugarcane". Juice from the cane is then sampled to determine the proportion of sucrose in the juice. On one basis of this test, a "standard quality factor" is assigned to the cane. The product of net tons and the standard quality factor is called "standard tons" and this is the unit of measurement to which the purchase price is applied.[14]

The purchase price is easily determined. If the price of sugar is, for example, 22.5 cents per pound, that amount is multiplied by 1.15, which is the "fair price determination factor" included in old Sugar Act and intended to ensure an equitable distribution of the mill's returns between independent producers (or cooperative members) and processors. Thus, with the example figures used, the price of one standard ton would be $25.88. An allowance is also made to account for the gallons of molasses obtained from the cane delivered to the mill.

SHORT- AND LONG-TERM PROSPECTS

After three decades of continued growth, Florida's sugar industry may have reached a plateau. Several factors seem to

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[13]Some of the information in this section appeared in Crane et al. (1982, p. 2).

[14]Administration cane for corporate mills was never subject to these provisions. Consequently, growers of this cane frequently do not concern themselves with standard tons, favoring instead the calculation of "yield" of commercially recoverable sugar as a percent of gross tonnage of cane delivered.

indicate not only that further expansions are unlikely but also that the industry may experience some contractions in the near future.

First, further acreage expansions are now restricted by the lack of available land close to existing mills. The building of new mills is a remote possibility since they require heavy capital investments unlikely to materialize in times of uncertainty. Furthermore, Glaz reported that in 1993, 32.3% of the plant cane was fallow planted, while 67.6% was successively planted (1994, p. 41), leaving little room for acreage expansion due to this practice. In addition, the establishment of production controls has legally curtailed even further the possibility of future expansions.

Second, environmental concerns may very well be a source of industry contraction. Under the settlement agreement between the United States and the South Florida Water Management District, the latter was required to purchase 34,700 acres of land in the EAA to be used for filtering phosphorus from drainage waters prior to entering the Water Conservation Areas and the Everglades National Park. These Stormwater Treatment Areas (STAs) will take away about 26,100 acres that were in cane production in 1991 (Hazen and Sawyer, 1992, p. ES-2). This fact alone will represent an industry contraction of 5.7%. Furthermore, studies are underway at the federal level to explore the possibility of the EAA's "full ecological restoration" that, if implemented, would translate in the flooding of thousands of acres now on sugarcane production in the EAA (Science Sub-group, 1993).

Third, the subsidence of organic soils will further reduce the industry acreage as time progresses. It has been predicted that "by the year 2000 there will be only about 80,000 acres of soil 3 feet or deeper, i.e., typical of the soil depths to which growers have adapted their crop management systems... [and] there probably will be over 500,000 acres of organic soil 3 feet or less in thickness, and half of this will be less than a foot in depth" (Snyder et al., 1978, p. 20). However, industry contraction may be slowed down with the adoption of new management practices such as the use of higher water tables and cultivars that can tolerate flooding for long periods of time.

Fourth, there are also pressures on the income side of the equation: (a) growers are required to pay an additional tax per acre (anticipated to be around $25) intended to generate revenues for cleaning up the EAA; (b) the implementation of Best Management Practices (BMPs) is adding extra costs to production; and (c) the next Farm Bill, up for debate and enactment in 1995, may contain a reduction in the 18-cent per pound loan price. Finally, there are issues related to international trade such as NAFTA, GATT, and the Cuban sugar quota (all discussed in detail later in this paper) that may adversely affect the Florida sugar industry.

On the positive side, the recent dramatic increase in mechanical harvesting represents a saving of approximately $4.50 per gross ton of cane harvested, or the difference between the $12 cost of hand-cut cane and the $7.50 cost of mechanically-cut cane. At the factory level, technological improvements have enhanced mill efficiency, translating into improved sucrose extraction rates.

MARKETS AND PRICES

POTENTIAL OF CUBAN SUGAR EXPORTS TO THE UNITED STATES: THE U.S. CUBAN SUGAR QUOTA[15]

Introduction

This section analyzes the potential of Cuban sugar exports to the United States by looking at different U.S. policy options related to the former U.S. Cuban sugar quota.

Prior to the revolution of 1959, the United States and Cuba had been major trading partners and sugar was Cuba's most important export to the United States. Until 1960, Cuba provided over one-third of the total U.S. sugar requirements, receiving in turn preferential prices and treatment in the form of allocating to Cuba almost all of the increases in U.S. consumption requirements. The July 1960 amendment to the Sugar Act provided for presidential actions under which sugar import quotas from Cuba were suspended. Explicit in the legislation was the intention of restoring Cuba's quota at the time of "its return to the free world". The Cuban sugar quota was allocated to domestic areas and foreign countries (Bates, 1968, p. 522).

The 1962 and 1965 amendments to the Sugar Act reallocated the Cuban sugar quota (Table 18). The 1965 amendment distributed the 50-percent Cuban share of the U.S. sugar requirements (remaining over the allocations to domestic sources, the Philippines, and other exceptions) on a pro-rata basis to other quota-holding countries. Not included in that quota, however, was Cuba's share arising from consumption requirements in excess of 10 million short tons, which would be prorated among members of the Organization of American States (Bates, 1968, p. 524).

Cuban exports of sugar to the United States amounted to 2.94 million tons in 1959. Until July 1960, when the Cuban quota was suspended, Cuba had exported 1.95 million tons of sugar to the United States.

The former total quantity of the Cuban quota, although temporarily suspended in 1960, has essentially disappeared as a

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[15]This section is an updated and expanded summary of the discussion appearing in Alvarez (1992).

Table 18. Reallocation of the Cuban sugar quota among foreign countries in the 1962 and 1965 amendments to the Sugar Act of 1948.[a]

Country	1962 Amendment	1965 Amendment	
		With Cuban share	Cuban share reallocated[b]
		-Percent-	
In Western Hemisphere			
Cuba	57.77	50.00	--
Mexico	6.71	7.73	15.46
Dominican Republic	6.71	7.56	15.12
Brazil	6.37	7.56	15.12
Peru	6.71	6.03	12.06
British West Indies	3.19	3.02	6.04
Ecuador	0.88	1.10	2.20
French West Indies	1.06	0.95	1.90
Argentina	--	0.93	1.86
Costa Rica	0.88	0.89	1.78
Nicaragua	0.88	0.89	1.78
Colombia	--	0.80	1.60
Guatemala	0.71	0.75	1.50
Panama	0.53	0.56	1.12
El Salvador	0.36	0.55	1.10
Haiti	0.71	0.42	0.84
Venezuela	--	0.38	0.76
British Honduras	0.35	0.22	0.44
Bolivia	--	0.09	0.18
Honduras	--	0.09	0.18
Paraguay	0.35	--	--
Outside Western Hemisphere			
Australia	1.41	3.60	7.20
Republic of China	1.24	1.50	3.00
India	0.71	1.44	2.88
South Africa	0.71	1.06	2.12
Fiji	0.35	0.79	1.58
Thailand	--	0.33	0.66
Mauritius	--	0.33	0.66
Malagasy Republic	--	0.17	0.34
Swaziland	--	0.13	0.26
Southern Rhodesia	--	0.13	0.26
Netherlands	0.35	--	--

[a]Quotas represent relative shares of U.S. sugar requirements remaining over the allocations to domestic sources, the Philippines, and other exceptions as stated in each amendment.
[b]Assuming U.S. consumption requirements of not over 10 million short tons.

Sources: U.S. Congress and U.S. Senate Reports as they appear in Bates (1968, p. 525).

result of decreasing imports brought about by expanded U.S. domestic production and shifts to less expensive substitutes caloric sweeteners like high fructose corn syrup. The three million tons average that Cuba exported to the United States in 1958 and 1959 represent twice the amount of total U.S. imports at present. Furthermore, the number of quota-holding countries, excluding Cuba, has increased from 21 in 1962 to 29 in 1965, and to 40 in recent years. Relative shares have also changed. However, it is interesting to note that, in previous cases similar to Cuba's, the U.S. Congress has reinstated sugar quotas withheld for political reasons at new levels that reflect U.S. current import requirements. That was the case of Nicaragua (withheld in 1985 and reinstituted in 1989), Panama (withheld in 1988 and reinstituted in 1989), and South Africa (withheld in 1987 and reinstituted in 1991). Since sugar exports have been historically the main source of foreign exchange for Cuba, it is not farfetched to anticipate some type of provision by the U.S. Congress to allow sugar imports from Cuba.

Alternative Policy Options

The following policy options depart from two assumptions. First, either before or after the U.S. economic embargo is lifted, Cuba has recovered its export capacity. As stated earlier in this report, Cuba's sugar output (in million metric tons) has drastically fallen from 7.62 in 1991 to 7.01 in 1992, to 4.3 in 1993, and to 4.0 in 1994. An even lower sugar output has already been forecasted for the 1995 campaign. Second, the U.S. economic embargo on Cuba has been lifted:

> The U.S. trade embargo against Cuba rests on three statutory sources: the Trading with the Enemy Act [of 1917 -TWEA], the Foreign Assistance Act [of 1961 -FAA], and the Cuban Democracy Act [of 1992]. The President has the legal authority to remove the embargo, to the extent that it is founded upon the TWEA and the FAA. Under those two statutes, the President could lift the embargo unilaterally, at any time, and without any preconditions, and would not be required to consult Congress in order to do so. Political considerations, of course, would probably dictate that the President work closely with Congress before taking any such action (Travieso-Díaz, 1993, p. 248).

Policy Option # 1

A potential source of sugar to be allocated to Cuba would involve the return of the shares of the Cuban quota allocated to different countries in the 1965 amendment to the Sugar Act. Needless to say, those shares would represent percentages of current quota allocations and not those of 1965. This option, however, would only represent an amount of around 48,000 tons per year when compared to the three million tons Cuba lost in 1960 (Table 19).

Table 19. Percent of the U.S. Cuban sugar quota reallocated to different countries in 1965 and corresponding 1965 and 1991-92 tonnage levels.

Country	Share of Cuban quota[a]	1965 tonnage[b]	1991-92 tonnage[c]
	Percent	- - -short tons- - -	
In Western Hemisphere			
Mexico	7.73	463,800	618
Dominican Republic	7.56	453,600	19,380
Brazil	7.56	453,600	15,966
Peru	6.03	361,800	3,601
British West Indies (Jamaica)	3.02	181,200	484
Ecuador	1.10	66,000	176
French West Indies	0.95	57,000	0
Argentina	0.93	55,800	582
Costa Rica	0.89	53,400	194
Nicaragua	0.89	53,400	272
Colombia	0.80	48,000	280
Guatemala	0.75	45,000	524
Panama	0.56	33,600	236
El Salvador	0.55	33,000	208
Haiti	0.42	25,200	34
Venezuela	0.38	22,800	0
British Honduras (Belize)	0.22	13,200	35
Bolivia	0.09	5,400	10
Honduras	0.09	5,400	13
Outside Western Hemisphere			
Australia	3.60	216,000	4,352
Rep. of China (Taiwan)	1.50	90,000	262
India	1.44	86,400	167
South Africa	1.06	63,600	536
Fiji	0.79	47,400	104
Thailand	0.33	19,800	67
Mauritius	0.33	19,800	58
Malagasy Rep. (Madagascar)	0.17	10,200	14
Swaziland	0.13	7,800	30
Southern Rhodesia (Zimbabwe)	0.13	7,800	23
Total		3,000,000	48,045

[a]From Table 18. It represents the difference between the reallocation of the Cuban quota and the country's previous share as stated in the 1965 amendment to the Sugar Act.

[b]Assumes U.S. quota allocation of 6 million short tons, and Cuba providing one-half.

[c]Calculated from U.S. sugar tariff rate allocations for 1991-92 (Economic Research Service).

Policy Option # 2

An additional source of sugar to be allocated to Cuba could be the difference between quota allocations and actual imports (Table 20). For example, in 1989-90, actual imports fell short of the quota allocation by 127,060 short tons. For 1990-91 and 1991-92, the figures were 72,112, and 49,686 short tons, respectively (Economic Research Service, June 1994, p. 58). Again, these figures would represent minimal amounts for Cuba.

Policy Option # 3

Finally, the provision in the old Sugar Act of allocating to Cuba almost all of the increase in U.S. consumption requirements could be temporarily enforced in new legislation to open the U.S. market to Cuban sugar. The U.S. Department of Agriculture has projected U.S. sugar consumption to rise about 100,000 tons per year from 1994 to 2000 (down from 170,000 in recent years) due to population and per capita use growth (Buzzanell, 1994, p. 7)

Feasibility and Impact

The three policy options would involve different outcomes in terms of their feasibility and potential impacts (Table 21).

Option # 1 would require minor changes in U.S. legislation. Its impact would be negligible for Cuba (around 48,000 tons per year), and would be negative for U.S. friendly countries. Rivero (1993, p. 10), however, has stated that, in 1965, sugar was a critical source of foreign exchange in Latin American countries only for the Dominican Republic (54% of export earnings), while it represented between 6% and 11% of export earnings to four other countries in the region. Many other countries had, and still do have, preferential access to the European Union's market. In summary, sugar exports for most of the current quota-holding countries is now a marginal source of foreign exchange while it has remained vital for Cuba.

Option # 2 would represent only about 50,000 tons per year. Its feasibility and impact would be identical to those identified in Option # 1.

Option # 3 would require a major change in U.S. legislation (the inclusion of the old provision concerning new increases in consumption), and would also entail the temporary enforcement of domestic marketing (production) controls already present in the Sugar Program. However, it would represent substantial amounts of sugar (around 100,000 per year) for Cuba in just a few years, and would pose no new burdens on domestic or foreign suppliers.

Table 20. U.S. sugar tariff rate quota allocations, actual imports, and net differences, 1989-90.

Country	1989-90 Quota allocat.	Actual imports	Net diff.
	- - - - -short tons, raw value - - - -		
Dominican Republic	508,162	508,162	0
Philippines	456,192	454,510	1,682
Brazil	418,656	395,795	22,861
Australia	239,644	239,644	0
Guatemala	138,590	138,590	0
Argentina	124,153	118,152	6,001
Peru	118,379	118,317	62
Panama	82,700	80,065	2,635
El Salvador	78,302	78,302	0
Colombia	69,296	69,296	0
Nicaragua	59,886	54,129	5,757
Costa Rica	54,849	54,849	0
Honduras	52,349	52,349	0
Swaziland	46,196	46,196	0
Thailand	40,422	40,102	320
Mozambique	37,535	37,431	104
Taiwan	34,648	34,648	0
Zimbabwe	34,648	34,648	0
Guyana	34,648	7,912	26,736
Mauritius	34,602	34,585	17
Canada	31,761	31,678	83
Belize	31,761	31,761	0
Ecuador	31,761	31,761	0
Jamaica	31,761	31,761	0
Malawi	28,734	28,734	0
Fiji	25,893	25,893	0
Bolivia	23,099	22,572	527
India	23,099	23,099	0
Barbados	20,212	8,236	11,976
Trinidad-Tobago	20,212	20,212	0
Congo	19,075	776	18,299
Cote D'Ivoire	19,075	19,075	0
Gabon	19,075	17,058	2,017
Haiti	19,075	12,939	6,136
Madagascar	19,075	19,075	0
Mexico	19,075	19,075	0
Papua New Guinea	19,075	18,996	79
Paraguay	19,075	8,567	10,508
St. Christopher-Nevis	19,075	8,040	11,035
Uruguay	19,075	18,850	225
South Africa	0	0	0
Subtotal	3,122,903	2,995,843	127,060
Specialty sugars	2,001	NA	NA
Total	3,124,904	NA	NA

NA=Not available. Quota allocations in numerical descending order and net differences calculated by the authors. Amounts entered in excess of quota level are deducted from following year's quota.
Source: Economic Research Service (June 1994, p. 58).

Table 21. Feasibility and impact of three alternative U.S. sugar policy options towards Cuba.

POLICY	TONS/YEAR	FEASIBILITY	IMPACT
1. RETURN COUNTRY SHARES TAKEN AWAY (IN TODAY'S QUOTAS)	48,000	MINOR CHANGES IN U.S. LEGISLATION	-NEGLIGIBLE FOR CUBA -NEGATIVE FOR U.S. FRIENDLY COUNTRIES
2. ALLOCATE DIFFERENCES BETWEEN ALLOCATIONS AND ACTUAL IMPORTS	50,000	SAME AS IN 1	SAME AS IN 1
3. ALLOCATE NEW INCREASES IN U.S. DOMESTIC CONSUMPTION	100,000	-A MAJOR CHANGE IN U.S. LEGISLATION, PLUS -ENFORCING DOMESTIC MARKETING CONTROLS (ALREADY IN FARM BILL)	-POSITIVE FOR CUBA -NO NEW BURDEN ON DOMESTIC OR FOREIGN PRODUCERS

POTENTIAL OF THE WORLD SUGAR MARKET

Background and Definition[16]

The bulk of the world's sugar output is consumed in the countries where it is produced. Domestic laws and bilateral or multinational agreements have tended to enhance self-sufficiency objectives. Thus, practically all sugar-producing countries of the world are affected by government interventions of some sort. These intervention policies insulate domestic sugar markets from the so-called "free" market defined below. For that reason, the domestic price of sugar does not necessarily reflect the price of sugar in the world market.

International sugar trade is conducted in private commercial channels, by government-to-government arrangements, and with government and commercial combinations. Considerable quantities of sugar are shipped across national boundaries under "special arrangements" such as Cuba's past agreement with the former Soviet Union and other Eastern European nations, the new Cuba-Russia agreement, agreements between the European Community and some of the former British Commonwealth countries, and import quotas under the U.S. sugar program.

The working of the world "free" market for sugar is not well understood. It is really a residual market or a market of leftovers from domestic needs and/or pre-arranged deals. In actuality, there are three kinds of sugar markets (Schmitz et al., 1984). First, there is the market for sugar within sugar-producing countries. Since most sugar is produced for the domestic markets, this market is the largest (75% of all sugar produced), and prices tend to be fairly stable. Secondly, there are various international agreements between certain importers and certain exporters (10%), e.g., those mentioned previously. Thirdly, there is a residual "free market" in sugar (the remaining 15%) which is occasionally regulated by International Sugar Agreements. This "free market" often becomes a dumping ground and remains relatively "thin" compared to world supply and demand. This world market can become quite volatile during periods of international tension, dramatic weather changes, and major shifts in sugar policies of major producing and/or consuming countries. Most countries seek to insulate their domestic sugar producers and consumers from the relatively volatile world market with a complex assortment of public policies and programs.

Trends in Selected World Sugar Parameters

World sugar trends can be appraised by looking at selected parameters during the period 1980-93, such as supply and demand,

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[16]This section draws heavily on Polopolus and Alvarez (1991, pp. 20-22, 30-31).

production and consumption, ending stocks, stocks to consumption ratios, and prices.

Supply and Demand

Supply (the sum of beginning stocks, production, and imports) and demand (the sum of exports and domestic consumption) experienced a somehow contrasting growth pattern during the 1980-93 study period (Table 22). In each of the 12 years under consideration (except for a minor decline in 1987-88), demand showed small but consistent increases. At the end of the study period, however, both supply and demand were exactly 22% higher (Fig. 5a) --as stronger increases in supply compensated for minor declines.

Production and Consumption

Domestic production and consumption in the producing countries showed more uneven growth patterns than supply and demand (Fig. 5a). Several ups and downs in production contrast with a steady growth in consumption. At the end of the study period consumption was a slightly higher level than production.

Ending Stocks

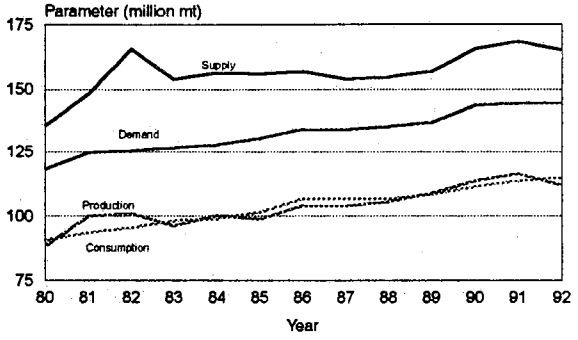
This is an important parameter because of its influence on prices. Ending stocks showed some changes during the study period but ended at a higher level (Table 22). There is a strong relationship between this parameter and prices (Fig. 5b).

Stocks to Consumption Ratios

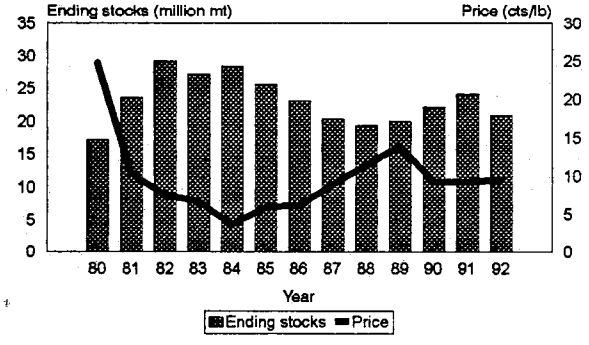
This parameter is even a better indicator of future price behavior. After a strong increase at the beginning of the study period, the declining tendency took this ratio to a lower level (Table 22). Price behavior is a reflection of the latter (Fig. 5c).

Price

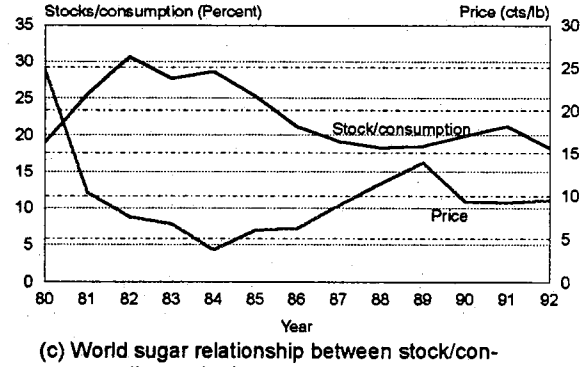
As stated above, average annual world prices for raw sugar reflect the previous conditions (Table 22). However, a deeper insight on price behavior is acquired when looking at average monthly prices for raw sugar during the study period (Figs. 6 and 7, and Table A-13. The study period (January 1980 through December 1993) contains 168 monthly price observations. The mean price was 10.61 cents per pound, with a minimum of 2.74 in June 1985 and a maximum of 41.09 cents per pound in October 1980. Price distributions were as follows:



(a) World sugar supply, demand, production, and consumption.



(b) World sugar relationship between ending stocks and price.



(c) World sugar relationship between stock/consumption and price.

Fig. 5. World sugar demand and supply parameters, 1980-81 through 1992-93.

Table 22. World sugar supply and demand parameters, 1980-81 through 1992-93.

Marketing year	Supply[a]	Demand[b]	Ending stocks	Stocks/ consump.	Price
	million metric tons, raw value			%	cts/lb
1980-81	135.59	118.35	17.24	19.01	24.80
1981-82	148.32	124.67	23.65	25.53	10.40
1982-83	154.65	125.42	29.23	30.64	7.58
1983-84	153.83	126.63	27.20	27.70	6.75
1984-85	156.45	128.06	28.39	28.65	3.68
1985-86	156.06	130.42	25.64	25.25	6.00
1986-87	157.05	133.93	23.12	21.17	6.20
1987-88	153.99	133.64	20.35	19.10	8.95
1988-89	154.58	135.14	19.44	18.26	11.50
1989-90	156.89	136.86	20.03	18.52	13.93
1990-91	165.78	143.60	22.18	19.92	9.39
1991-92	168.42	144.31	24.11	21.22	9.23
1992-93	165.31	144.32	20.93	18.22	9.56

[a]The sum of beginning stocks, production, and imports.

[b]The sum of exports and domestic consumption. Calculated by the authors.

Source: Economic Research Service (June 1994, p. 4).

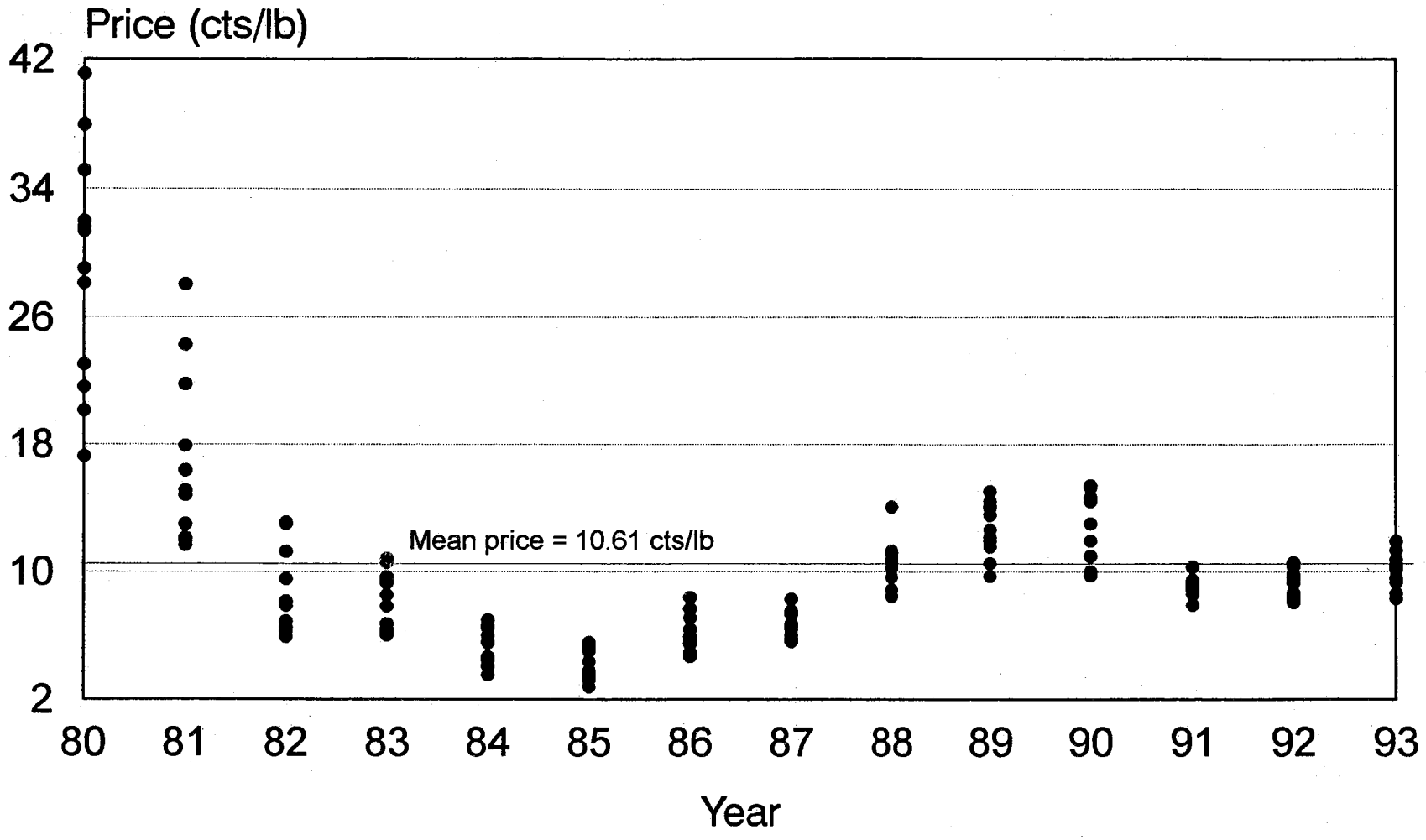


Fig. 6. World average raw sugar monthly prices, January 1980 through December 1993.

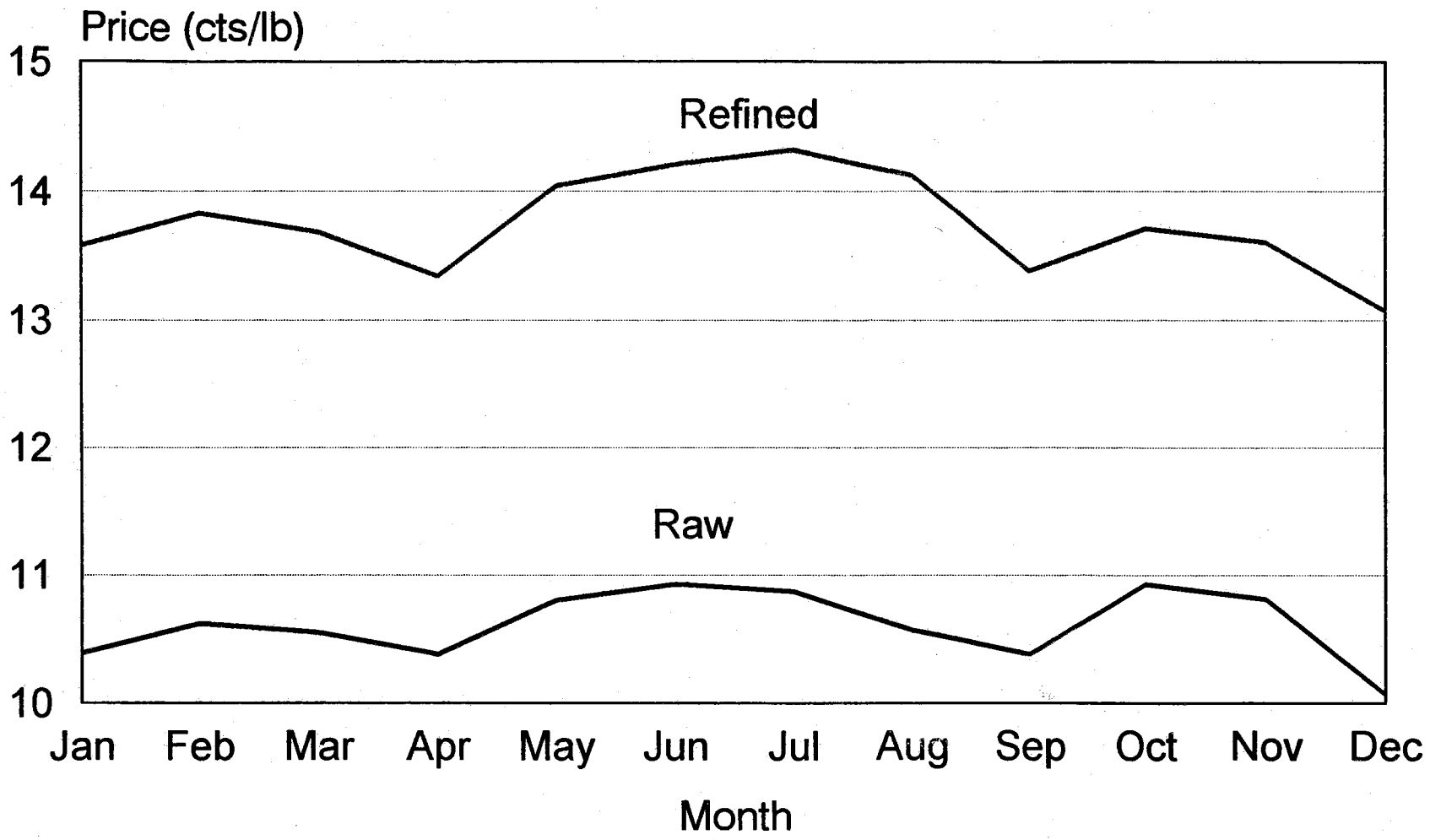


Fig. 7. Price spread between world average monthly raw and refined sugar prices, January 1980 through December 1993.

Price range (cts/lb)	No. of observations	Percent
2.74 - 7.00	51	30.3
7.01 - 12.00	78	46.4
12.01 - 17.00	23	13.7
17.01 - 22.00	5	3.0
22.01 - 27.00	2	1.2
27.01 - 32.00	6	3.6
32.01 - 37.00	1	0.6
37.01 - 42.30	2	1.2
Total	168	100.0

Although these figures will be discussed in a later section of this report, it becomes obvious that most of the observations fell within a range that makes it impossible to cover costs in most of the producing countries.

Additional insights are obtained when looking at the behavior of average monthly prices for refined sugar (Fig. 7 and Table A-14). The mean price was 13.74 cents per pound, with a minimum of 5.90 in May 1985 and a maximum of 42.30 cents per pound in October 1980. Price distributions were as follows:

Price range (cts/lb)	No. of observations	Percent
5.90 - 10.00	54	32.1
10.01 - 15.00	77	45.8
15.01 - 20.00	15	8.9
20.01 - 25.00	10	6.0
25.01 - 30.00	3	1.8
30.01 - 35.00	2	1.2
35.01 - 40.00	5	3.0
40.01 - 42.30	2	1.2
Total	168	100.0

Again, and as expected, most of the observations fell at the lower end of the price spectrum. Finally, the spread between refined and raw sugar prices seems to have been around 3 cts in favor of the former (Fig. 7).

World Sugar Trade

As stated in a previous section, the bulk of the world's sugar output is consumed in the countries where it is produced. World sugar trade encompasses agreements through private commercial channels, government-to-government agreements, and other government and commercial combinations. The leftovers (about 15%) go to the "free market".

World sugar trade by leading exporters and importers is shown in Table 23. The seven leading exporters accounted for more than 20 million metric tons in the last years, which represented more than 70% (around 78% in the last marketing year) of total world exports. On the other hand, the seven leading importers accounted for around

Table 23. World sugar trade by leading sugar exporters and importers, 1990-91 through 1993-94.

Country or area	Marketing year 1990-91	1991-92	1992-93	1993-94
	million metric tons, raw value			
Sugar exporters				
Cuba	6.80	6.10	3.80	3.50
European Union	5.58	4.88	5.58	6.33
Ukraine	3.45	1.50	1.98	2.11
Australia	2.82	2.35	3.48	3.49
Thailand	2.74	3.66	2.33	2.80
Brazil	1.30	1.61	2.43	2.30
China	0.32	1.42	2.10	2.60
Total	22.69	21.52	21.70	23.13
World total	32.26	30.71	29.39	29.75
	Percent			
Leading exporters share of global exports	70.33	70.07	73.83	77.74
	million metric tons, raw value			
Sugar importers				
Former Soviet Union	4.20	6.47	5.78	5.78
European Union	1.88	1.89	2.01	1.98
United States	2.57	2.00	1.86	1.61
Japan	1.76	1.80	1.77	1.70
China	1.06	1.23	0.51	1.03
Canada	1.11	0.96	1.01	1.13
Korea, Rep. of	1.23	1.26	1.23	1.26
Total	13.81	15.61	14.17	14.49
World total	27.32	28.26	27.22	28.82
	Percent			
Leading importers share of global imports	50.55	55.24	52.06	50.28

Notes: European Community excludes intra-EC trade but includes Unified Germany. United States is based on offshore receipts and includes sugar imports for re-export.

Source: Economic Research Service (June 1994, p. 8).

14 million metric tons, which represented around 50% of total world imports.

Of special importance is the status of the sugar industry in the Russian Federation. After a thorough industry analysis, Markish and Buzzanell (1994), have stated:

> The Russian Federation can reduce its sugar import dependency by raising production and curbing consumption growth. However, for the foreseeable future Russia is likely to remain a substantial importer of both raw and refined sugar. Giving continuing hard currency problems for imports, barter trade with Cuba and China will remain important (p. 29).

Growth in Caloric and Artificial Sweeteners

In addition to sugar, other caloric sweetener products include corn sweeteners (high fructose corn syrup, glucose, and dextrose). Pure honey and edible syrups are considered minor caloric sweeteners, while noncaloric sweeteners (also referred to as artificial and high-intensity sweeteners) include aspartame, saccharin, and acesulfame-K, and a few others pending approval from the Food and Drug Administration (Fig. 8).

With the increase in consumption of sugar substitutes and noncaloric products, the U.S. sugar market has become a sweeteners market. In 1965, relative shares of the total 123.2 pounds per capita U.S. consumption were as follows: refined sugar had 78%, corn sweeteners had 15%, noncaloric sweeteners had 5%, and syrups and honey had 2%. In 1993 the 147.2 pounds per capita consumed in the United States were distributed as follows: 40.4% as refined sugar, 45.6% as corn sweeteners, 13.1% as noncaloric sweeteners, and 19% as syrups and honey (Table A-15 and Fig. 9).

Although high fructose corn syrup (HFCS) has taken a large amount of the market share previously held by refined sugar in the United States, the drastic changes started in the early 1960s came to an end in 1985. Since that year, both HFCS and refined sugar show a parallel growth pattern (Fig. 10). HFCS has been the determinant factor in the growth of caloric sweeteners (Table A-15).

The world's HFCS market appears to be following the steps of the U.S. market. World production of HFCS grew at the same rate it did in the United States (Table A-16 and Fig. 11). From 1980 through 1993, U.S. and world production of HFCS expanded by around 225%. At the end of the study period, however, the United States still held the 75% share shown in 1980. Growth rates are larger for Argentina, South Korea, Taiwan, and Other countries, while they were smaller for Canada, the European Union, and Japan. As a result, no drastic changes in market share are shown (Fig. 12).

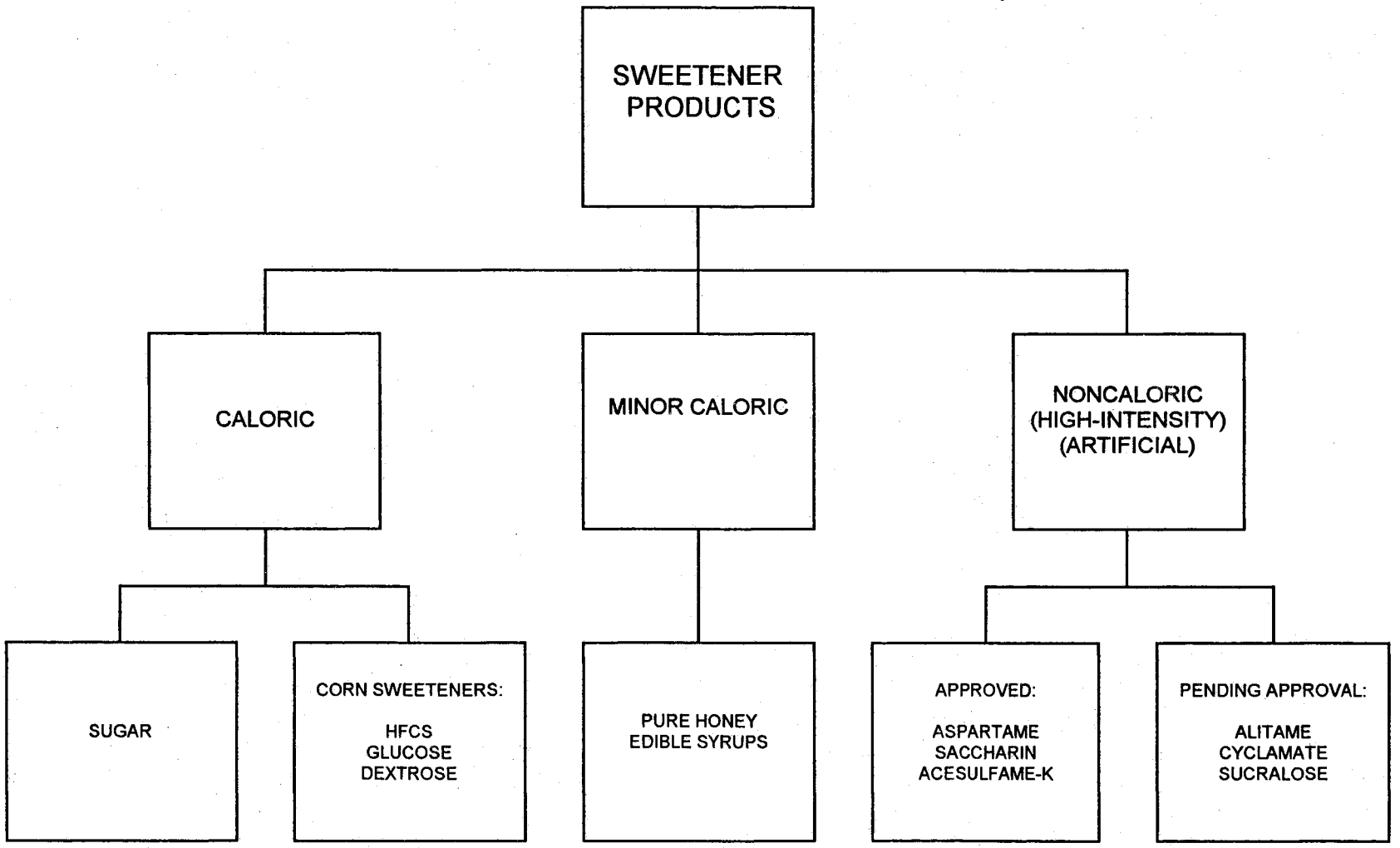


Fig. 8. Type and status of sweetener products in the U.S. market, 1993.

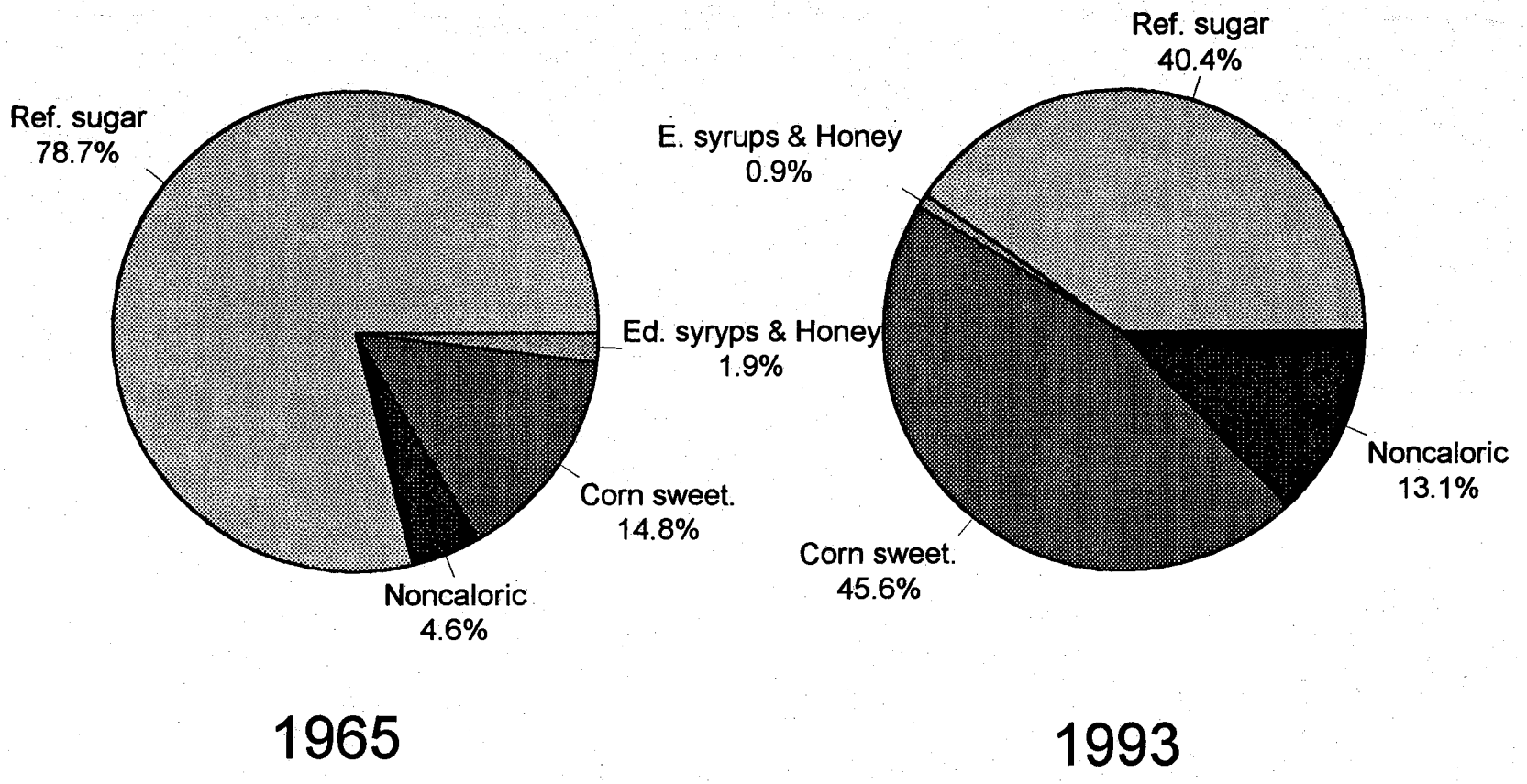


Fig. 9. Market shares of sweetener products in the United States, 1965 and 1993.

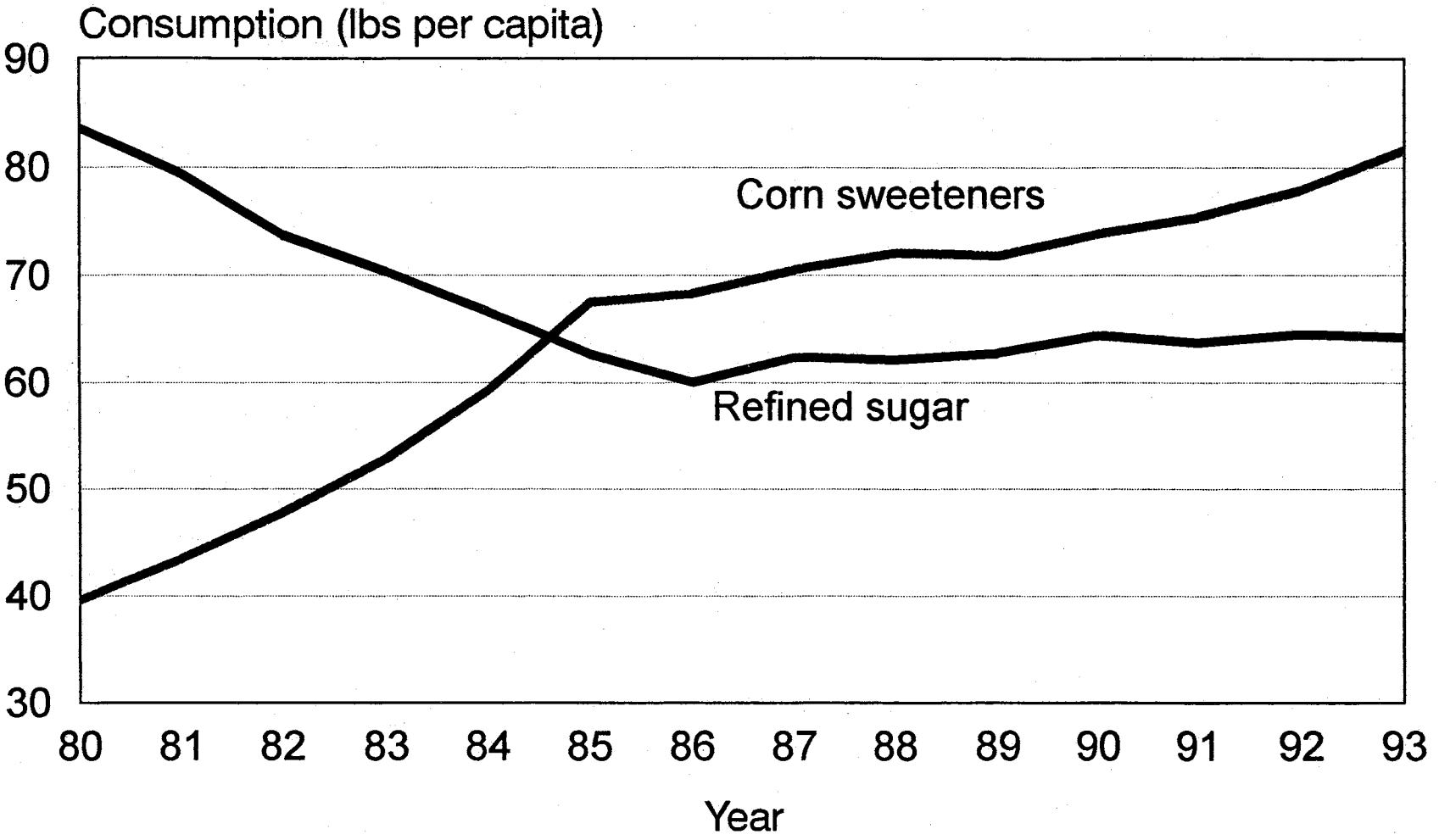


Fig. 10. Per capita consumption of refined sugar and corn sweeteners in the United States, 1980-93.

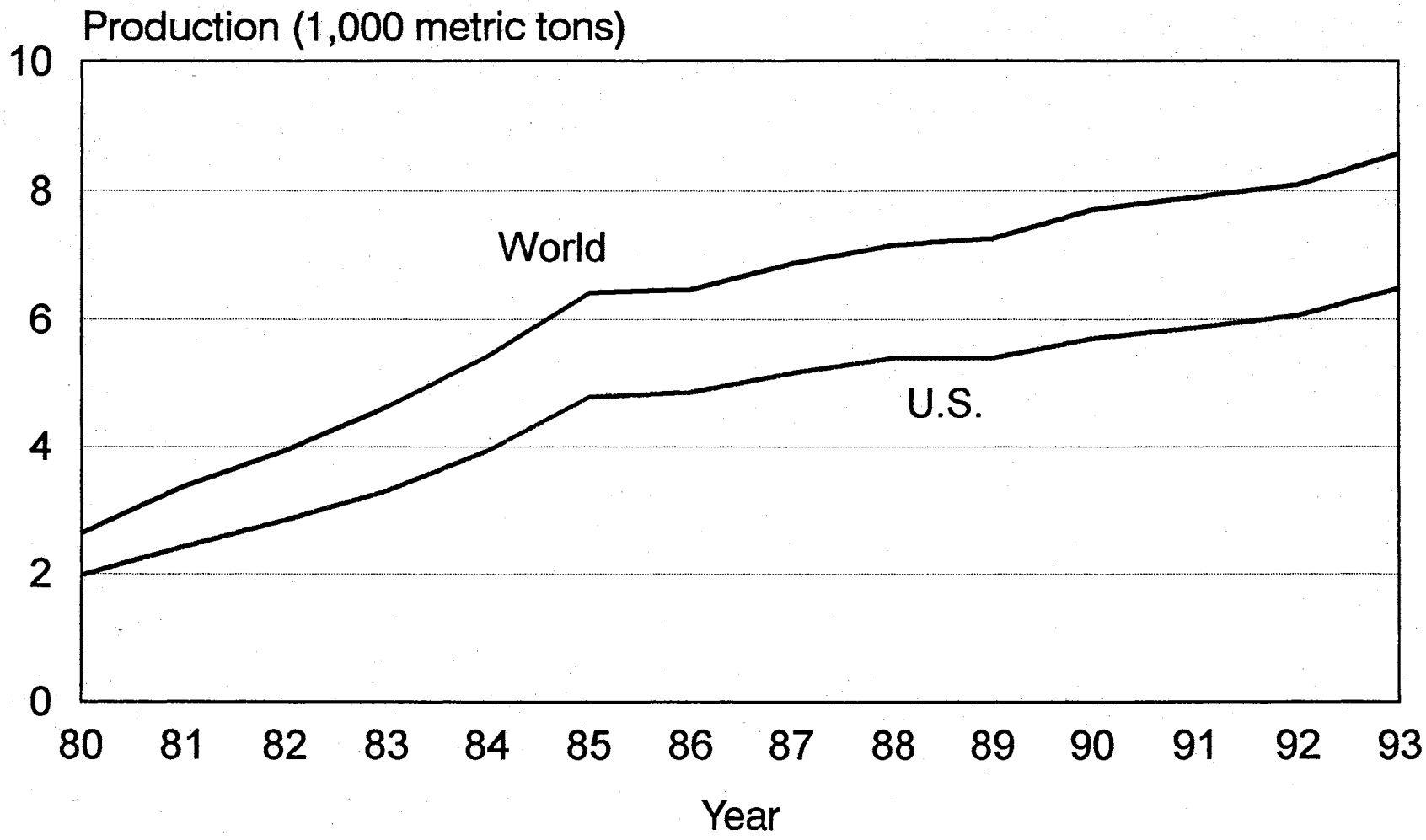
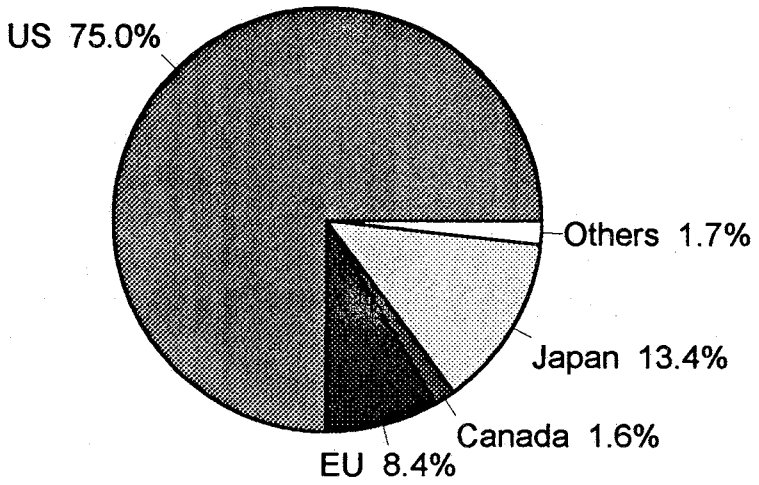
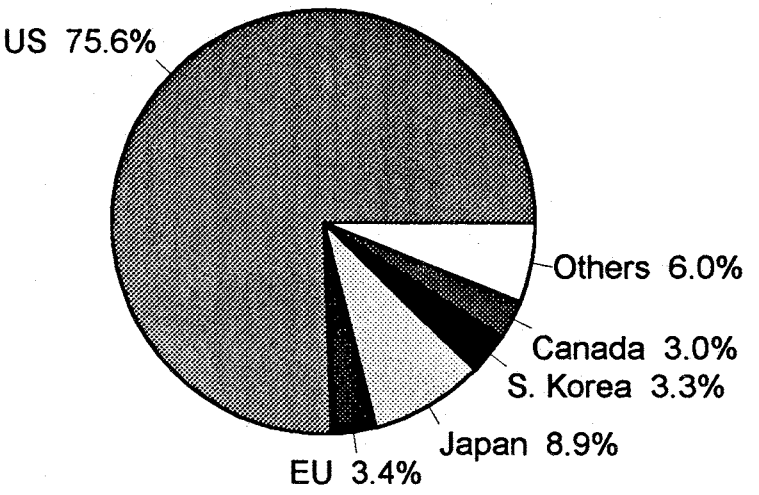


Fig. 11. World and U.S. production of high fructose corn syrup, 1980-93.



1980



1993

Fig. 12. World production shares of high fructose corn syrup by selected countries, 1980 and 1993.

The world's tendency to demand more artificial sweeteners seems to indicate increasing growth rates in a not so distant future. As in the United States, several products have already been approved, or are pending approval, in Canada, Europe, and Japan (Table A-17). These products will add pressure to the sugar market because of their relative sweetness when compared with sugar (Table A-17 and Fig. 13).

Potential Impact of Trade Agreements

The International Sugar Agreements (ISA)

International commodity agreements are designed to dampen sharp fluctuations of prices in the free market. International Sugar Agreements were negotiated effective in 1953, 1958, 1968, and 1977 between major exporting and importing countries. Overall, the performance of these agreements has been disappointing (Polopolus and Alvarez, 1991, p. 31).

To minimize sharp price fluctuations, the ISAs assigned initial export quotas pro rata to agreed tonnages. Should prices fall on the free market below an agreed minimum, quotas were reduced. Conversely, when prices rose above an agreed maximum, quotas were increased among exporting countries (Polopolus and Alvarez, 1991, p. 31).

The 1977 ISA is a good example. During the life of the agreement, the price remained within the target range only in 12 out of a possible 84 complete months, or 14% of the time. The main reason for this apparent failure was the lack of effective instruments to make cuts needed to backup the price range (FAO, 1985).

Perhaps due to the failure of the 1977 ISA, another agreement did not materialize during intense negotiations in 1982-84. The idea of a new international sugar agreement appears to be dead. Viton (1994b, p. 30) has noted that the three most recent agreements ISAs (1958, 1968, and 1977) have been only administrative to keep in existence the International Sugar Organization as a forum for inter-governmental consultation and for statistics gathering and economic research. It should remain in that capacity as a resource institution for the implementation of the GATT agreement.

The North American Free Trade Agreement (NAFTA)[17]

In December 1993, the President of the United States signed into law legislation authorizing the NAFTA, which became effective

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[17]Most of the information in this section was summarized from Polopolus et al. (1994b).

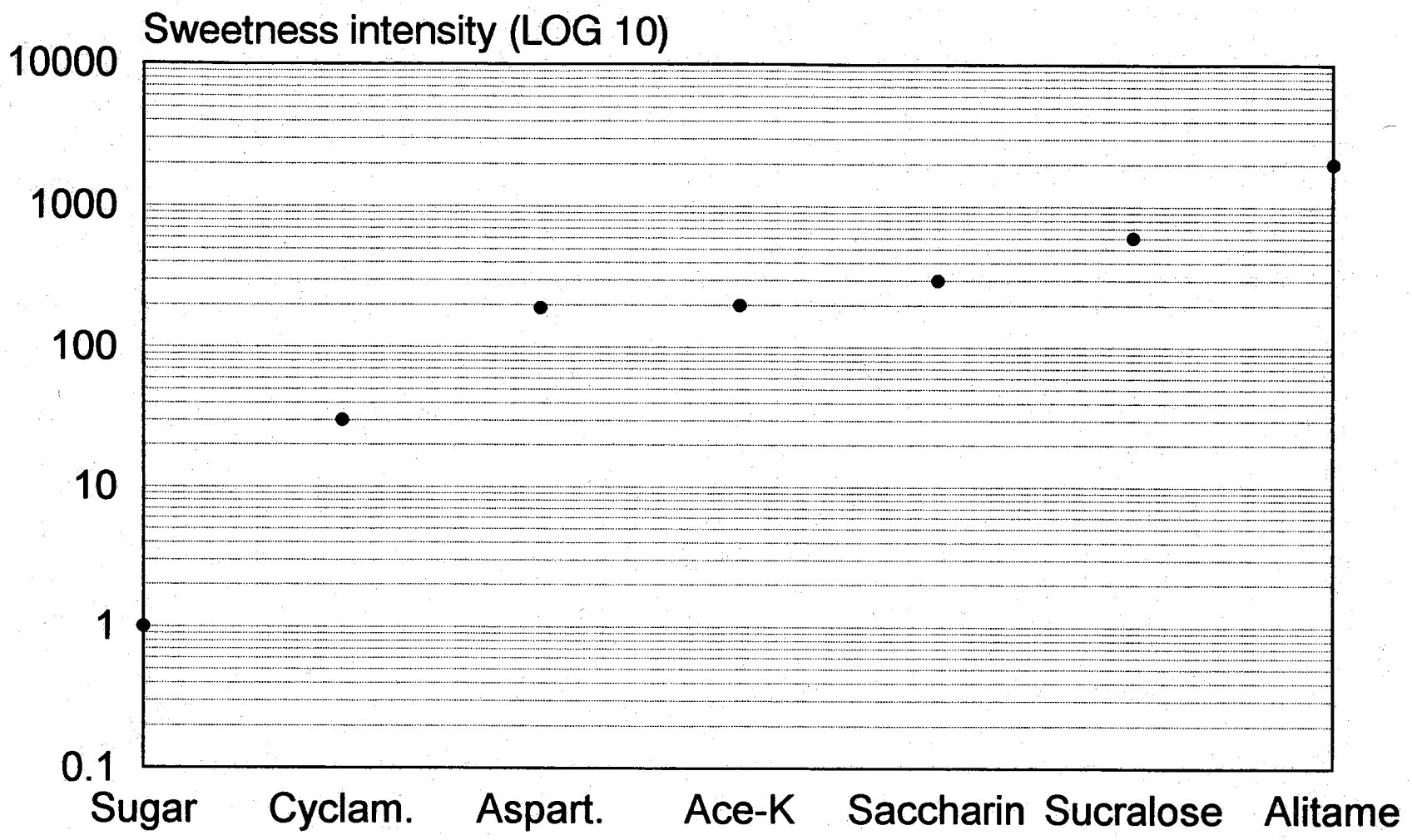

Fig. 13. Sweetness intensity of artificial sweeteners in relation to sugar.

January 1, 1994. The Canadian Parliament and the Mexican Senate had previously approved the agreement.

NAFTA will eliminate most trade barriers among the United States, Canada, and Mexico, either immediately or over a period of up to 15 years. The recently concluded agreement does not include sugar trade between the United States and Canada, since this matter was covered by the U.S.-Canada Free Trade Agreement of 1989.

The original draft of the NAFTA between Mexico and the United States regarding sugar would have permitted Mexico to increase duty-free exports of sugar to the United States from its current level or about 7,258 metric tons of raw sugar to a maximum of 25,000 metric tons. However, duty free shipments in excess of the original 7,258 metric ton level would be limited to Mexico's net sugar production surplus (domestic sugar production minus domestic sugar consumption).

In the seventh year of the agreement, Mexico's maximum duty-free access level for sugar exports to the United States would increase to 150,000 metric tons under the same net sugar production surplus provisions specified for the first six years. Moreover, Mexico was permitted to have unlimited access to the U.S. sugar market if it became a net exporter for two successive years following the sixth year of the agreement.

These original proposals created considerable debate. Three of the major issues included: (a) the potential substitution of high fructose corn syrup for sugar in Mexico's soft drink industry (that could free up to 1.3 million metric tons of sugar for other uses) allowing Mexico to achieve net exporter status in sugar; (b) the fate of 39 other U.S. quota holders if Mexico achieved unlimited access to the U.S. market; and (c) the fate of the U.S. sugar program if Mexico could dump huge quantities of sugar onto the U.S. market. These issues were a major factor in the development of a "side agreement" for sugar.

In the side agreement, the formula for determining Mexico's net surplus production was amended to include high fructose corn syrup on the consumption side only. Thus, Mexican sugar production would have to exceed Mexican consumption of both sugar and HFCS for Mexico to be considered a net surplus producer, which severely diminishes Mexico's chances for becoming a major sugar supplier to the United States.

During phase one of the agreement (year 1 through 6), Mexico will have duty-free access for sugar exports to the United States for the amount of its net surplus production, up to a maximum of 25,000 metric tons, raw value. If Mexico is not a net surplus producer, it will still have duty free access for 7,258 tons, or the minimum "boat-load" amount authorized under the U.S. tariff rate quota. For comparison purposes, Mexico exported an average of

12,667 tons in the four years prior to NAFTA.

During phase two (years 7 through 14), Mexico will have duty-free access to the U.S. market for the amount of its surplus as measured by the formula, up to a maximum of 250,000 tons, with the minimum duty-free access still at the minimum "boat-load" amount. The side agreement eliminated the unlimited sugar access provision contained in the original NAFTA language.

The tariff system in the U.S. Sugar Program still applies. However, both countries will have reduced their second-tier tariffs between themselves to zero by the fifteenth year of the agreement.

U.S. refiners shipping sugar to Mexico under the U.S. refined sugar re-export program will be guaranteed Most Favored Nation status, but NAFTA will not provide any special benefit for re-export sugar because it is not considered U.S. in origin. NAFTA does, however, allow for reciprocal duty-free access between both countries for refined sugar which is refined from raw sugar produced in either country.

In summary, NAFTA reinforces the *status quo*. The integrity of the U.S. Sugar Program is guaranteed as well as the tariff rate quota system benefiting 39 other friendly countries.

The General Agreement on Tariffs and Trade (GATT)[18]

After seven years of negotiations, the Uruguay Round of the GATT came to a conclusion on December 15, 1993. Over 100 nations agreed to reduce tariffs and non-tariff barriers covering a wide array of agricultural and non-agricultural products and services. The signing of the agreement was scheduled for April 15, 1994 to become effective on July 1, 1995.

Provisions of the agreement are to be phased-in over a six year period for developed countries and 10 years for developing countries beginning on July 1, 1995. The four basic tenets of the agricultural provisions included: (a) reduction in export subsidies by developed countries; (b) reduction in internal price supports; (c) tariffication of non-tariff barriers and tariff reduction; and (d) minimum market access.

Export subsidies of developed countries must be reduced 36% by value and 21% by volume of exports. Reductions are to be applied on a commodity-by-commodity basis. Since the United States does not subsidize sugar exports, this provision has no direct effect on Florida sugar producers. However, it could influence the world

[18]Most of the information in this section was summarized from Polopolus et al. (1994a), and appeared originally in several issues of Economic Research Service.

market for raw sugar if and when sugar export subsidies of the European Community, particularly, are reduced or curtailed.

Internal price supports and subsidies must be reduced by 20% in the aggregate from 1986-88 base period levels. Reduction is not required on a commodity-by-commodity basis. U.S. agricultural programs were "GATT-ready" from the provisions of the 1985 and 1990 farm acts, which required that commodity price supports be lowered, on average, by more than 20%. As a result, there is no requirement from GATT that the loan rate of 18 cents per pound for Florida raw sugar production be reduced.

Tariffication consists in the conversion of import quotas to tariffs to achieve the same level of protection. These tariffs are then to be reduced by 36% (24% for developing countries) on average for all of a nation's commodities, with a minimum reduction of 15% (10% for developing countries) required for each commodity. The United States applied this tariffication procedure to sugar imports in 1990. Sugar was the first U.S. commodity converted to tariffication, well ahead of the GATT's requirements. The current second-tier tariff rate for sugar imports into the United States is 17 cents per pound, raw value. Under the new GATT, it will be reduced by 15%, reaching a level of 14.45 cents per pound in the sixth year of the agreement.[19]

A minimum market access equal to 3% of domestic consumption is to be established initially. Individual countries are also required to increase it to 5% over the six years of the agreement. The United States has already achieved this goal since U.S. sugar imports are already around 15% of its annual sugar consumption. Nevertheless, the United States agreed under GATT to commit itself to import 1.256 million short tons (including 24,250 short tons of refined sugar) of sugar annually, considerably above the minimum market access rules of GATT.

In summary, while liberalizing world trade moderately over a long term horizon, the new GATT will not have much impact in the immediate future on either world sugar trading patterns or world raw sugar prices. However, by the turn of the century, this agreement will begin to affect production patterns somewhat. More importantly, GATT has placed an upper limit on future increases in protection. As sugar analysts have noted,

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[19]The U.S. tariff in the year 2000 (around 14.5 cents per pound), in combination with transportation costs (about 1.5 cents per pound) would protect a U.S. raw sugar market price of about 22 cents per pound as long as the world price is above 6 cents per pound. During the 1950-93 period, the monthly average world price (in 1993 prices) was less than 6 cents per pound only 5% of the time (Lord, 1994).

> any impact from the GATT agreement on the international sugar industry -one of the world's most protected- will be extremely slow and it could be years before there is any noticeable response from such major producers as the EC (Sugar y Azucar, 1994, p. 38).

The degree to which GATT will begin to affect production patterns somewhat by the turn of the century is not clear yet. Viton (1994a) has stated the following:

> the projected demand growth by the year 2000 is double the actual consumption growth since 1987/88. Since my analysis of production expansion plans and potentialities -at current sugar prices- does not indicate that production will rise by a corresponding amount, the inference must be that price will respond (p. 35).

The projections do not show a trend change in North America, Western Europe, and Oceania, no optimism for growth in African countries, and slight increases in Latin America. The biggest changes are projected for Eastern Europe and Asia (p. 36).

SUMMARY AND CONCLUSIONS

The section on the Cuban sugar industry has shown the exhaustion of the state extensive growth model that was based on large state farms. In 1993 it was replaced with a new form of organization and management called the Basic Units of Cooperative Production. The success of the UBPCs will largely depend on the capability of the Cuban economy to transcend its current crisis and provide the necessary inputs and technology to the sugar industry. Following an integrated crop management program with the needed resources, Cuba could again produce large quantities of sugar to regain its place as one of the top sugar producers in the world.

The section on the Florida sugar industry seems to indicate that, after several decades of growth, it has reached a plateau. Geographical and legal constraints may impede further expansion, while biological and environmental factors may lead to some contraction.

Both industries may soon face the issue of the restoration of at least part of the former U.S. Cuban sugar quota. The United States now imports from 40 countries about one-half the amount imported just from Cuba three decades ago. Policy prescriptions that may or may not affect domestic producers and/or foreign suppliers would include: (a) allocate to Cuba the annual differences between quota allocations and actual imports (a range between 50,000 and 100,000 short tons); (b) return to Cuba the shares of the Cuban quota allocated to different countries in the 1965 amendment to the Sugar Act (around 50,000 short tons); and (c) go back to the provision of the Sugar Act that allocated to Cuba

almost all of the increases in U.S. domestic consumption (several thousand tons depending on the length of the enforcement).

Both Florida and Cuba are affected by the world sweetener market. This paper has shown that, during the 1980s and early 1990s, no major change in world sugar parameters has taken place. The world's tendency on artificial sweeteners, however, seems to indicate increasing growth rates in a not so distant future. Sugar demand projections, on the other hand, exhibit some degree of optimism concerning prices at the turn of the century. Still, there seems to be a consensus on the slowness of the response of the world sugar industry to the liberalization measures contained in GATT.

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Table A-1. Main indicators of Cuba's sugar agroindustry, 1969-90.

Year	Sugar Product.	Cane Product.	Yield 96°	Agric. yield	Area with cane 12/31	Harv. area	Total plant.	Spring plant.	Cold plant.
	Million mt	Million mt	Percent	1000 mt/ha	- - - - - - - - -		1000 ha	- - - - - - - - -	
1969	4.46	40.3	11.02	43.8	1544	950	286	227	58
1970	8.54	79.5	10.71	55.5	1635	1469	128	70	58
1971	5.92	51.4	11.49	41.4	1446	1259	252	123	130
1972	4.32	43.4	9.96	37.2	1395	1199	355	188	167
1973	5.16	48.1	10.87	44.7	1430	1079	408	277	131
1974	5.82	50.3	11.73	45.3	1457	1110	389	255	134
1975	6.20	52.3	12.21	44.1	1516	1188	421	288	134
1976	6.04	53.7	11.63	43.7	1542	1231	420	266	154
1977	6.37	60.3	11.34	52.7	1640	1145	408	213	196
1978	7.22	69.6	10.76	55.9	1650	1245	313	200	114
1979	7.84	77.2	10.74	54.9	1696	1320	344	232	112
1980	6.52	63.9	10.78	44.2	1669	1400	406	275	131
1981	7.20	66.5	11.08	53.0	1735	1216	543	424	120
1982	8.03	73.0	11.17	53.4	1763	1335	348	215	127
1983	6.95	69.6	10.35	55.0	1754	1207	238	136	101
1984	8.03	77.3	10.47	55.8	1760	1358	290	174	116
1985	7.82	67.3	11.99	49.0	1770	1355	342	224	117
1986	7.09	68.4	10.62	50.1	1774	1336	355	213	142
1987	6.95	70.7	10.64	48.0	1789	1366	397	239	158
1988	7.42	67.5	10.85	51.7	1759	1305	339	201	136
1989	8.12	73.9	10.83	54.5	1797	1355	360	236	124
1990	8.04	74.4	10.65	52.0	1774	1427	289	182	108

Source: Compiled by Sulroca (1994) with MINAZ data.

Table A-2. Average relative participation, in terms of milled cane, of Cuban provinces in sugarcane harvests, 1971-75, 1976-80, 1981-85, and 1986-90.

Province	Time period 1971-75	1976-80	1981-85	1986-90
		-Percent-		
Pinar del Río	1.84	1.89	2.32	2.82
Habana	10.61	10.04	8.94	8.42
Matanzas	13.05	12.96	11.77	11.49
Villa Clara	11.35	11.64	11.66	11.78
Cienfuegos	6.08	5.93	6.83	6.99
Sancti Spíritus	5.66	5.80	5.63	6.11
Ciego de Avila	10.33	11.18	11.08	10.11
Camagüey	10.09	10.52	11.39	11.85
Las Tunas	8.41	8.70	8.95	8.92
Holguín	10.61	9.56	9.37	8.65
Granma	5.29	5.73	6.19	6.60
Santiago de Cuba	4.97	4.34	4.68	4.68
Guantánamo	1.69	1.69	1.39	1.53

Source: MINAZ, Anuario Estadístico (1990, p. 2).

Table A-3. Average national and provincial sugarcane agricultural yields in Cuba, 1981-85, 1986-90, and 1981-90.

National province	1981-85	1986-90	1981-90
		mt/ha	
National	53.2	51.3	52.3
Pinar del Río	58.8	58.5	58.6
Habana	69.9	68.8	69.4
Matanzas	58.3	59.0	58.7
Villa Clara	54.1	52.7	53.4
Cienfuegos	54.3	51.4	52.8
Sancti Spíritus	48.4	48.0	48.2
Ciego de Avila	51.7	48.1	49.6
Camagüey	50.5	48.1	49.3
Las Tunas	46.5	40.8	43.7
Holguín	48.3	46.2	47.2
Granma	54.1	53.0	53.6
Santiago de Cuba	55.1	56.9	56.0
Guantánamo	43.9	49.4	46.6

Source: MINAZ, Anuario Estadístico (1990, pp. 24-37).

Table A-4. Cuba's sugarcane production costs at the provincial and national levels, 1982, and 1986 through 1990.

Province	Season					
	1982	1986	1987	1988	1989	1990
	Pesos/mt					
Pinar del Río	21.38	17.89	19.03	18.37	18.18	19.74
Habana	12.35	13.98	13.81	13.19	14.17	13.92
Matanzas	11.30	16.12	15.72	14.03	15.22	13.92
Villa Clara	13.51	16.60	12.29	15.67	17.46	16.70
Cienfuegos	14.60	16.14	15.76	14.74	16.40	14.87
Sancti Spíritus	14.33	15.96	16.15	13.47	15.21	15.09
Ciego de Avila	12.90	16.36	17.75	15.65	16.06	13.36
Camagüey	12.74	14.64	15.07	13.12	13.69	14.80
Las Tunas	15.06	14.79	16.20	14.70	15.32	19.74
Holguín	12.55	13.27	15.10	12.90	13.06	15.37
Granma	15.55	16.69	17.66	14.60	17.48	18.96
Santiago de Cuba	14.43	14.15	13.91	13.61	15.17	16.92
Guantánamo	18.49	21.01	16.42	16.66	18.30	18.62
Country	13.66	15.49	16.23	14.40	15.44	15.88

Source: MINAZ, Anuario Estadístico (1990, pp. 230-231).

Table A-5. Cuba's sugarcane production cost at the national level, per selected activity, 1981, and 1986 through 1990.

Activity	Season					
	1981	1986	1987	1988	1989	1990
	Pesos/ mt					
Growing	7.81	9.18	10.04	8.75	9.80	10.71
Harvesting & load.	5.70	6.31	6.18	5.65	5.65	5.16
Total	13.51	15.49	16.22	14.40	15.45	15.87

Source: MINAZ, Anuario Estadístico (1990, p. 232).

Table A-6. Cuba's domestic price and cost per metric ton of sugar, 1984-90.

Year	Agric. cost	Total cost	Domestic price	Agric. cost/ total cost	Cost/ peso
	-----	-Pesos-	-----	Percent	Pesos
1984	132.63	186.30	161.83	71.2	1.15
1985	143.78	177.71	161.83	80.9	1.10
1986	145.67	207.61	161.83	70.2	1.28
1987	152.35	217.21	161.83	70.1	1.34
1988	132.53	194.17	161.83	68.3	1.20
1989	142.44	207.46	161.83	69.7	1.28
1990	148.90	210.48	161.83	70.7	1.30

Source: MINAZ, Anuario Estadístico (1990, pp. 227, 309, 313).

Table A-7. Actual days, effective days, and time lost in Cuba's sugar seasons, 1971, 1981, and 1986-89.

Item	Season					
	1975	1981	1986	1987	1988	1989
Harvesting days	123	136	137	141	128	145
Effective days	99	114	104	99	100	109
Time lost (%)						
real total	18.24	14.73	21.80	27.32	20.05	23.10
rains	0.64	3.75	5.87	11.58	2.94	7.41
lack of cane	3.59	1.82	4.80	3.03	2.90	3.72
cleaning	3.79	2.94	3.09	2.81	3.51	3.15
interruptions	4.21	2.03	2.85	4.31	4.52	3.86
equip. break.	4.67	2.56	2.92	3.43	3.50	3.56

Source: CEE, Anuario Estadístico de Cuba (1989, p. 151).

Table A-8. Relationship between harvested area and area with cane on December 31st., 1969-70 through 1989-90.

Harvest season	Relationship
	- -Percent - -
1969-70	95.10
1970-71	77.00
1971-72	82.92
1972-73	77.35
1973-74	77.62
1974-75	81.54
1975-76	81.21
1976-77	74.26
1977-78	75.91
1978-79	80.03
1979-80	82.56
1980-81	72.90
1981-82	76.96
1982-83	68.45
1983-84	77.44
1984-85	77.00
1985-86	75.48
1986-87	77.02
1987-88	72.98
1988-89	77.05
1989-90	79.41

Source: Calculated by the authors from Table A-1.

Table A-9. Average planting and stubble replacement of Cuba's sugarcane fields, 1977-89.

Year	Plantings to replace fields	Harvested area to be replaced
	- - - - - - - - 1000 ha - - - - - - - -	
Seven-year cycle and six cuttings		
1977	290.52	163.48
1978	298.08	177.79
1979	306.99	188.59
1980	298.62	199.93
1981	286.06	173.74
1982	283.90	190.75
Six-year cycle and five cuttings		
1977	296.32	190.75
1978	297.94	207.49
1979	308.88	220.05
1980	292.81	233.28
1981	280.31	202.77
1982	287.01	222.48
1983	295.11	201.15
Five-year cycle and four cuttings		
1977	312.25	228.96
1978	306.31	248.94
1979	310.90	264.06
1980	292.27	279.99
1981	269.59	243.27
1982	280.26	267.03
1983	300.91	241.38
1984	303.07	271.62
Four-year cycle and three cuttings		
1977	320.08	286.20
1978	328.86	311.17
1979	324.67	330.07
1980	290.52	350.05
1981	263.11	304.15
1982	266.62	333.85
1983	296.05	301.72
1984	312.25	339.52
1985	304.15	338.85
Three-year cycle and two cuttings		
1977	290.52	381.64
1978	344.65	414.85

Continued

Table A-9. Continued.

1979	360.58	440.10
1980	302.13	466.69
1981	251.23	405.40
1982	257.17	445.09
1983	283.23	402.30
1984	309.42	452.65
1985	316.71	451.84
1986	307.12	445.50

Sources: CEE, Anuario Estadístico de Cuba (Various Issues); MINAZ Anuario Estadístico (Various Issues).

Table A-10. Selected indicators of Cuba's Basic Units of Cooperative Production (UBPC) in sugarcane, by province, December 1993.

Province	Number	Range of size (ha)					Agric. area	No. of workers
		<540	541-810	811-1080	1081-1350	>1350		
		#					1000 ha	-#-
Pinar del Río	47	10	24	12	1	-	37.8	3709
Habana	48	3	7	9	7	22	86.4	6989
Matanzas	107	6	22	23	20	36	141.7	9500
Villa Clara	235	53	120	50	6	6	229.5	18599
Cienfuegos	158	34	104	18	1	1	137.7	8325
Sancti Spíritus	103	21	24	16	14	28	128.2	9196
Ciego de Avila	104	-	4	35	25	40	176.8	13507
Camagüey	193	8	51	61	32	41	230.8	17138
Las Tunas	201	29	89	48	25	10	205.2	19189
Holguín	117	5	9	30	23	50	201.1	18493
Granma	128	29	68	19	8	4	120.1	16915
Santiago de Cuba	86	27	42	11	6	-	68.8	12138
Guantánamo	29	1	12	13	3	1	41.8	4480
Nation	1556	226	576	345	171	238	1806.3	158178
CPA	386							
State farms	11						31.1	1047

Source: MINAZ (1994).

Table A-11. Estimated revenues, costs, and margins for a 640-acre sugarcane farm on the muck soils of southern Florida, 1990-91.

Item	Revenues and costs			
	Per acre	Per st. ton	Total	Percent
	- - - - - - $ - - - - - -			
Total revenues[a]				
Plant cane	1,501		241,602	33.7
First ratoon	1,456		234,358	32.7
Second ratoon	1,194		192,204	26.7
Molasses payment	77		49,087	6.9
Total	1,121	27.78	717,251	100.0
Total variable costs				
Land preparation	25.7	0.64	16,434	2.9
Planting	81.2	2.01	51,990	9.2
Plant cane cultivation	13.1	0.32	8,365	1.5
Ratoon cane cultivation	60.9	1.51	38,991	6.9
Overhead activities	19.3	0.48	12,367	2.2
Miscellaneous[b]	20.0	0.50	12,815	2.3
Interest	26.4	0.66	16,915	3.0
Harvesting	411.2	10.19	263,177	46.6
Total	657.7	16.31	421,054	74.6
Total fixed costs				
Machinery and equipment	64.9	1.61	41,563	7.4
Land charge	125.0	3.10	80,000	14.2
Taxes: land and drainage	35.1	0.87	22,438	4.0
Total	225.0	5.58	144,001	25.6
Summary of revenues and costs				
Revenues	1,120.7	27.78	717,251	100.0
Variable costs	657.9	16.31	421,054	58.7
Gross margin	462.8	11.47	296,197	41.3
Fixed costs	225.0	5.58	144,001	20.1
Net margin	237.8	5.89	152,196	21.2

[a]Total revenues are divided by 161 acres in plant cane and in the two ratoons, and by 640 acres in molasses. The remaining calculations are based on 640 acres.
[b]At 12% of previous variable costs and include pick-up truck use, office supplies, telephone, accounting services, dues, etc.

Source: Alvarez and Schueneman (1991, p. 16).

Table A-12. Estimated total returns to factors of production per gross acre for a 640-acre sugarcane farm on the muck soils of southern Florida, 1990-91.

Item	Charge	Return
	- - - $/gross acre- - - -	
Total revenues		1,121
Variable costs	658	
Return to fixed costs, land, and management and risk		463
Fixed costs	100	
Return to land, and management and risk		363
Land charge	125	
Return to management and risk		238

Source: Alvarez and Schueneman (1991, p. 17).

Table A-13. World raw sugar monthly prices, January 1980-December 1993.[a]

Year	Month											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	cents/pound											
1980	17.23	23.03	20.12	21.61	31.33	31.61	28.12	31.98	35.12	41.09	37.94	29.00
1981	28.04	24.27	21.77	17.90	15.08	16.35	16.32	14.76	11.66	12.13	11.96	12.96
1982	12.99	13.05	11.24	9.53	8.12	6.85	7.83	6.80	5.90	5.91	6.50	6.27
1983	5.98	6.40	6.18	6.71	9.27	10.80	10.53	10.52	9.46	9.67	8.52	7.82
1984	6.95	6.58	6.42	5.96	5.58	5.48	4.51	4.01	4.11	4.66	4.41	3.51
1985	3.59	3.66	3.78	3.37	2.77	2.74	3.15	4.35	5.14	5.01	5.53	5.37
1986	4.87	5.55	7.07	8.36	7.64	6.36	5.58	5.50	4.67	5.42	5.93	5.66
1987	6.47	7.32	7.51	6.64	6.71	6.40	6.03	5.57	5.79	6.60	7.28	8.25
1988	9.64	8.40	8.48	8.49	8.85	10.52	14.04	11.09	10.18	10.29	10.82	11.28
1989	9.69	10.49	11.54	12.14	11.93	12.63	14.01	13.96	14.13	14.42	15.02	13.52
1990	14.38	14.63	15.39	15.24	14.62	12.99	11.92	10.92	11.00	9.77	10.00	9.72
1991	8.88	8.57	9.22	8.55	7.88	9.37	10.26	9.45	9.39	9.10	8.79	9.03
1992	8.43	8.06	8.22	9.53	9.62	10.52	10.30	9.78	9.28	8.66	8.54	8.15
1993	8.27	8.61	10.75	11.30	11.87	10.35	9.60	9.30	9.52	10.27	10.10	10.47
Mean	10.39	10.62	10.55	10.38	10.80	10.93	10.87	10.57	10.38	10.93	10.81	10.07

[a]Contract No. 11, f.o.b. stowed Caribbean port, including Brazil bulk spot price.

Source: Economic Research Service (June 1994, p. 46).

Table A-14. World refined sugar monthly prices, January 1980-December 1993.[a]

Year	Month											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
	cents/pound											
1980	20.06	26.13	23.60	24.34	35.55	35.40	33.32	35.16	37.29	42.30	40.72	33.70
1981	33.03	29.83	27.56	21.48	18.79	20.22	19.38	17.59	13.80	14.85	14.71	14.86
1982	14.77	14.94	13.60	13.05	11.83	10.50	11.38	9.14	8.58	8.54	9.64	10.35
1983	9.69	9.70	9.75	10.00	12.26	14.07	13.36	13.19	11.79	11.89	10.38	10.71
1984	9.61	8.76	8.27	7.89	7.40	7.62	6.88	6.95	7.48	7.79	7.36	6.51
1985	6.43	6.25	6.03	6.00	5.90	6.00	6.19	7.16	7.95	7.71	8.02	7.86
1986	7.63	7.97	8.95	10.10	9.49	8.43	8.11	8.51	8.03	8.16	8.26	8.05
1987	8.65	9.23	9.45	8.66	8.64	8.24	8.09	8.09	8.36	8.56	8.96	10.03
1988	11.41	10.51	10.67	10.86	11.25	12.39	14.85	12.46	11.62	11.94	12.76	13.39
1989	12.63	13.41	14.52	15.19	15.90	17.70	21.19	22.45	19.79	18.00	18.08	17.00
1990	19.01	19.55	20.03	20.31	20.33	18.36	17.42	16.54	14.39	13.99	14.01	13.85
1991	13.39	13.40	13.86	12.90	12.99	13.94	14.73	14.40	13.09	13.03	12.71	12.46
1992	12.18	11.92	12.19	12.54	12.89	13.41	13.41	12.96	12.29	11.94	11.68	11.26
1993	11.60	11.97	13.05	13.38	13.39	12.64	12.20	13.05	12.90	13.23	13.15	12.97
Mean	13.58	13.83	13.68	13.34	14.04	14.21	14.32	14.12	13.38	13.71	13.60	13.07

[a]Contract No. 5, London Daily Price for refined sugar, f.o.b. Europe, spot price.

Source: Economic Research Service (June 1994, p. 46).

Table A-15. Total and relative per capita consumption of caloric sweeteners in the United States, 1980-93.

Year	Refined sugar	Corn sweeteners				Pure honey	Edible syrups	Total
		HFCS	Glu-cose	Dex-trose	Total			
	- - - - - - - - - - - - pounds, dry basis (relative percentage) - - - - - - - - - - - -							
1980	83.6 (67.2)	19.0	16.8	3.8	39.6 (31.8)	0.8 (0.6)	0.4 (0.3)	124.4
1981	79.4 (64.0)	22.8	16.9	3.8	43.5 (35.0)	0.8 (0.6)	0.4 (0.3)	124.1
1982	73.7 (60.0)	26.6	17.3	3.9	47.8 (38.9)	0.9 (0.7)	0.4 (0.3)	122.8
1983	70.3 (56.5)	31.2	17.6	4.0	52.8 (42.4)	1.0 (0.8)	0.4 (0.3)	124.5
1984	66.6 (52.4)	37.3	17.9	4.1	59.3 (46.6)	0.9 (0.7)	0.4 (0.3)	127.2
1985	62.7 (47.7)	45.2	18.1	4.2	67.5 (51.3)	0.9 (0.7)	0.4 (0.3)	131.5
1986	60.0 (46.3)	45.8	18.3	4.2	68.3 (52.7)	1.0 (0.8)	0.4 (0.3)	129.7
1987	62.4 (46.4)	47.8	18.4	4.3	70.5 (52.4)	1.1 (0.8)	0.4 (0.3)	134.4
1988	62.1 (45.8)	49.1	18.7	4.3	72.1 (53.2)	0.9 (0.7)	0.4 (0.3)	135.5
1989	62.8 (46.2)	48.4	19.0	4.4	71.8 (52.8)	1.0 (0.7)	0.4 (0.3)	136.0
1990	64.4 (46.1)	49.8	19.5	4.5	73.8 (52.9)	1.0 (0.7)	0.4 (0.3)	139.6
1991	63.7 (45.3)	50.7	20.2	4.5	75.4 (53.7)	1.0 (0.7)	0.4 (0.3)	140.5
1992	64.5 (44.8)	52.3	21.1	4.5	77.9 (54.2)	1.0 (0.7)	0.4 (0.3)	143.8
1993[a]	64.2 (43.6)	55.3	21.8	4.5	81.6 (55.4)	1.0 (0.7)	0.4 (0.3)	147.2

[a]Preliminary.

Source: Economic Research Service (June 1994, p. 78). Relative percentages calculated by the authors.

Table A-16. World production of high fructose corn syrup by selected countries, 1980-93.

Calendar year	United States	Canada	Argen-tina	Europ. Union	Japan	South Korea	Taiwan	Others	World total	U.S. as a % of world total
	1,000 metric tons, dry basis									
1980	1,978	42	6	222	353	16	NA	22	2,639	74.9
1981	2,426	85	21	256	511	41	NA	34	3,374	71.9
1982	2,846	110	40	260	579	69	NA	60	3,946	72.1
1983	3,305	140	145	259	583	95	NA	98	4,625	71.5
1984	3,935	180	154	273	631	133	NA	118	5,424	72.5
1985	4,782	210	156	287	680	144	NA	158	6,417	74.5
1986	4,851	234	159	267	682	153	15	110	6,471	75.0
1987	5,158	237	169	265	724	182	15	126	6,876	75.0
1988	5,396	240	164	271	710	219	19	144	7,163	75.3
1989	5,392	240	146	276	744	244	51	165	7,258	74.3
1990	5,697	240	157	280	784	270	67	209	7,704	74.0
1991	5,872	250	154	284	778	276	110	180	7,904	74.3
1992	6,062	250	150	286	761	263	125	196	8,093	74.9
1993	6,485	255	153	288	760	282	150	208	8,581	75.6

NA = Not available.

Source: Economic Research Service (June 1994, p. 17).

Table A-17. Regulatory status of high-intensity sweeteners in major producing regions of the world, 1991.

Sweetener	Relative sweetness (x sugar)	Region			
		U.S.	Canada	Europe	Japan
Acesulfame-K	200	A	P	A	N
Aspartame	180	A	A	A	A
Cyclamate	30	P	A	A	N
Saccharin	300	A	N	A	A
Stevioside	300	N	N	N	A
Sucralose	600	P	A	P	P

A = Approved. P = Petition filed. N = Not approved.

Source: Economic Research Service (December 1991, p. 24).