

# **STRUCTURAL DEVELOPMENTS IN THE MEXICAN GRAIN/LIVESTOCK SUBSECTOR: THE GRAIN AND OILSEED SUBSECTOR**

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## **INTRODUCTION**

Population growth and changes in eating habits constitute the forces behind the country's fast-growing feed industry. Mexico's annual consumption of livestock products—meat, dairy products and eggs—grew by 3.2 percent annually during the past seven years, and reached 17 million tons during 1997. This rapid growth in consumption has ensued from a rapidly expanding population and from a fast-growing per-capita consumption. The country's population, now 96 million, grew by 1.96 percent annually during this period. Meanwhile, per-capita yearly consumption of livestock products went from 161.5 kilos in 1990 to 176.1 kilos in 1997, in spite of its significant drop in 1995 and 1996 for most products as a result of the economic crisis.<sup>1</sup>

The rapid growth in the consumption of livestock products has caused rapid expansion of the domestic demand for feed. Nationwide apparent consumption of feed has grown by 3.4 percent annually since 1990, and reached 15 million tons\* per annum in 1997. Practically all of the demand has been satisfied by domestic production. The industry has, however, become increasingly dependent on imports to meet its expanding demand for grains and oilseeds.

This paper first describes the Mexican feed industry today, and discusses its evolution in recent years. Next, it reviews the importance that the main grains and oilseeds have as inputs in the industry, and the role of imports in the satisfaction of the industry's demand for these products. In order to assess the strength of the linkage between imports of each feed grain/oilseed and the domestic feed industry, the annual volume of imports of individual products since 1990 is regressed linearly against volumes produced in the industry. The regression coefficients indicate the expected change in the volume of imports of a grain/oilseed (in tons), for every additional ton of feed produced.

Recent changes in policy, geared towards a greater role of markets and improved productivity, are affecting the supply and demand of grains and oilseeds. Policy changes are briefly discussed in the third section of the paper. A description of the recent evolution of each crop's competitiveness, based on survey data from FIRA, a Mexican development bank specialized in lending to commercial producers, is presented in the fourth section of the document. The paper ends with a summary and conclusions.

## **THE MEXICAN FEED INDUSTRY**

According to the Mexican Chamber of the Manufacturing Industry (Canacintra) (1998), Mexico's domestic feed production reached roughly 14.8 million tons in 1997, a 6 percent

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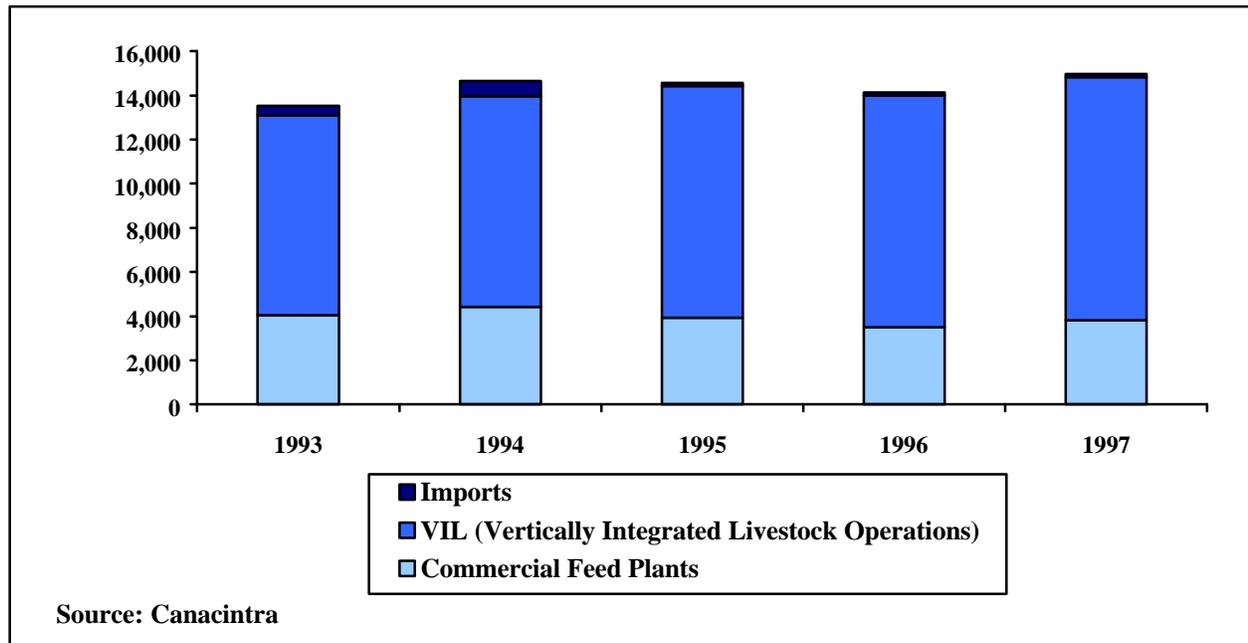
<sup>1</sup> These are the author's calculations with data from Conapo-PEF (1995) and Canacintra (1998).

\* Author's note: "tons" refers to metric tons.

increase over 1996. Based on data from the Mexican Statistics Institute (INEGI, 1997) on volume (which grossly underestimates Canacintra's), the average sales price in 1997 was US\$250 per ton.<sup>2</sup> Canacintra's volume valued at INEGI's average price implies a value of sales for 1997 of US\$3.708 billion.

Compared with commercial feed plants, vertically-integrated livestock (VIL) operations have been better able to survive the input and output price adjustments brought about by trade liberalization and by the recent economic crisis. The industry has, therefore, experienced a drastic restructuring in the past decade and a half. While a decade and a half ago VIL operations produced only 30 percent of the country's feed, today their share is 74 percent (Figure 1). The significant drop in production in commercial operations during 1995 and 1996, not evident in VIL operations, suggests that livestock producers started their own feed production plants as a survival tactic in response to the recent slump in demand for some livestock products, increased import competition, and high inflation.

**Figure 1. Apparent Consumption and Sources of Feed in Mexico, 1993-97**



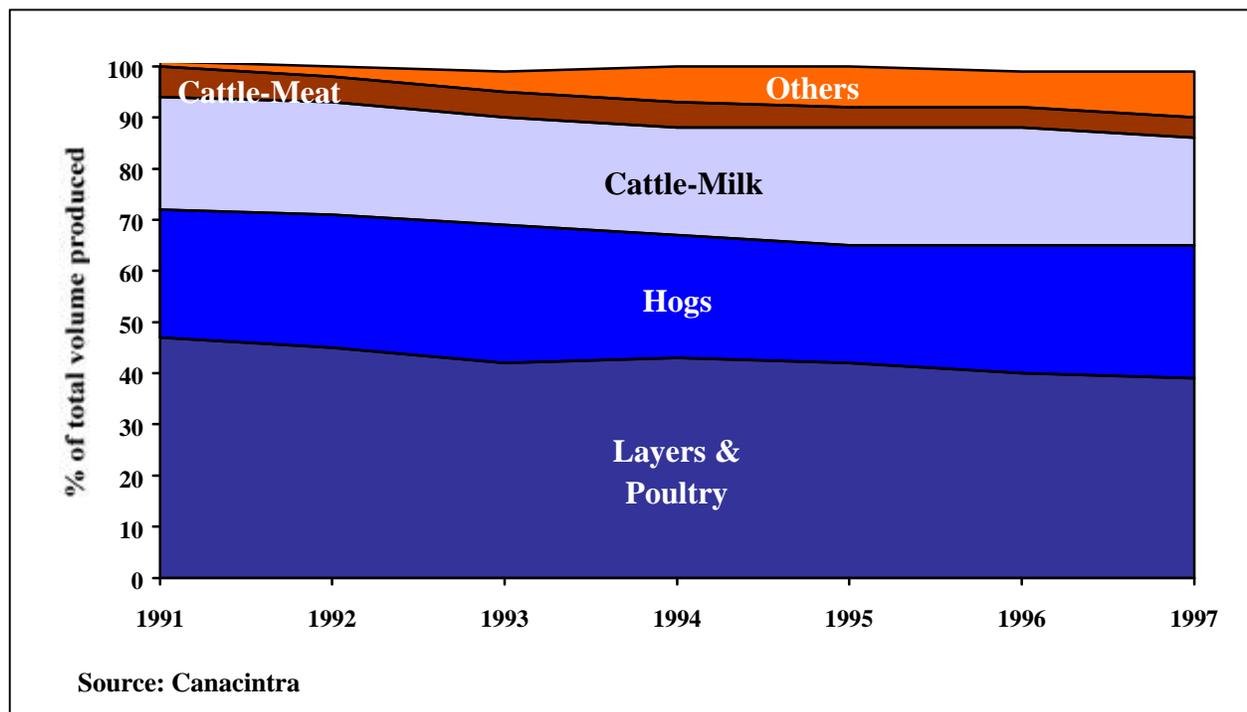
According to INEGI (1995), there were 442 feed manufacturing plants in Mexico in 1994. Five of these were "big-sized" (with 251 or more employees each, and individual average annual sales of US\$22.8 million each); 20 were "medium-sized" (with 101 to 250 employees, and average annual sales of US\$27.0 million each); 182 were "small-sized" (with 16 to 100 employees, and average annual sales of US\$7.6 million each); and 234 were "micro-sized" (with 15 employees or less, and average annual sales of US\$157 thousand). Although more recent estimates from INEGI are not available, Canacintra's records indicate a total of 360 feed plants in Mexico for 1997, with a total installed capacity of 20 million tons annually, 26 percent which remained idle that year. According to Canacintra, VIL operations comprise two-thirds of

<sup>2</sup> INEGI reports a volume of 5.584 million tons for 1997.

the industry's installed capacity. In 1997, smaller-sized plants, usually VILs, were operating on 92 percent of their installed capacity, which contrasts with the underutilization of the larger-sized commercial plants, which last year operated at an average 48 percent of their installed capacity.

In 1997, the Mexican feed industry delivered almost 39 percent of its output to producers of layers and poultry, 26 percent to pork producers, 21 percent to bovine milk producers, and 4 percent to beef producers. Feed-to-meat (milk) conversion ratios were 2.340, 3.415, 0.333, and 0.942, respectively. The remaining 9 percent of output was bought by ovine, caprine, and aquaculture operations, or by manufacturers of pet food (Canacindra, 1998; Figure 2).

**Figure 2. Percent Share of Volume Produced by the Mexican Feed Industry, by Type of End User, 1991-97**



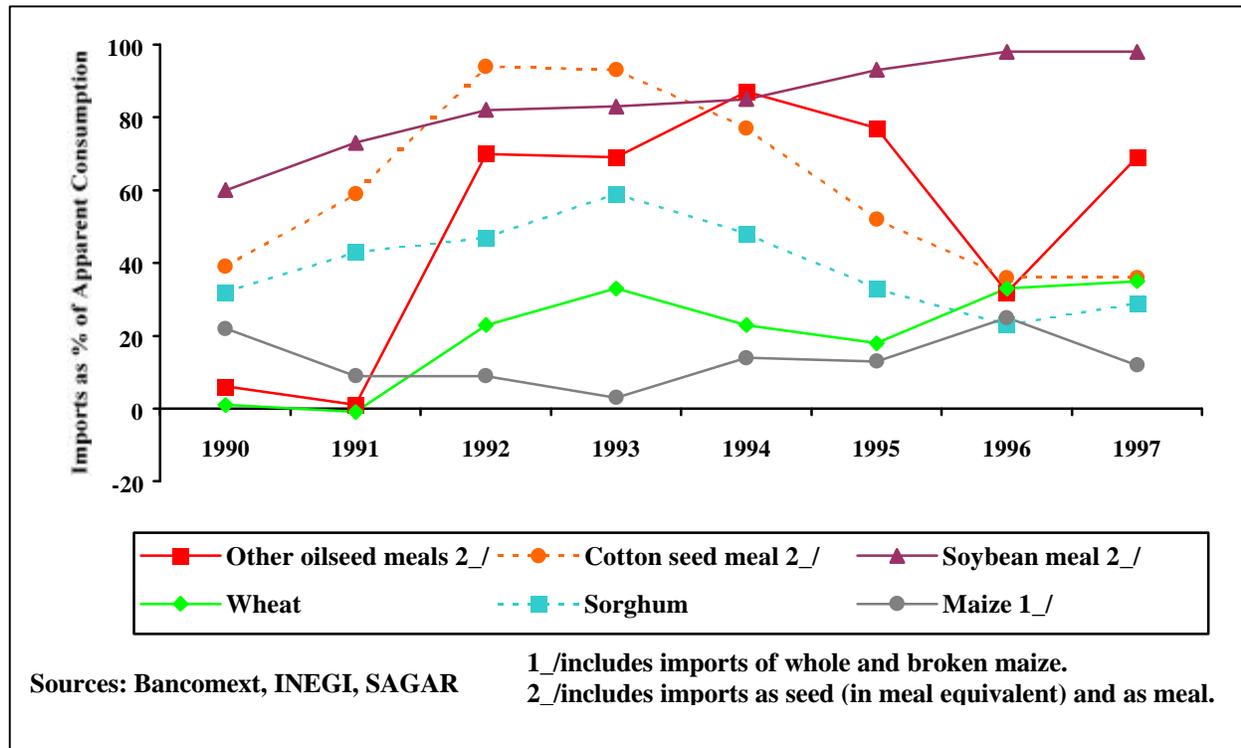
Mexico's domestic feed production satisfies practically all of domestic demand. In 1997, imports represent only 1 percent of domestic utilization. But the industry imports an important share of its intermediate inputs. According to INEGI (1997) intermediate input costs represented 83 percent of the value of the feed industry's sales that year, and based on Canacindra's data on the volume of sales and INEGI's average price, such costs reached US\$3 billion. INEGI-STPS<sup>3</sup> (1995) reports that in 1994, the total cost of imported intermediate inputs for the industry was 12 percent of the industry's intermediate input costs that year. If this same share is assumed for 1997, it implies imports of intermediate inputs worth US\$369 million.

The feed industry's main inputs are grains, oilseeds and their subproducts, and for many inputs there is a strong import dependency. According to INEGI (1994), grains, oilseeds and their subproducts constituted 85 percent of the volume and 69 percent of the value of the typical

<sup>3</sup> STPS stands for the Mexican Ministry of Labor.

feed mix in 1993. According to Canacintra (1998), the share of grains and oilseeds in the volume of output averaged 62 percent and 15 percent, respectively, during 1996-1997. As shown in Figure 3, imports in the last two years supplied a fifth of the domestic apparent consumption of sorghum, 98 percent of that for soybean meal (imported as whole soybeans or as meal), over a third of that for cottonseed meal (imported as whole cottonseed or as meal), and over half of that for other oilseed meals (imported as whole seeds or as meals).

**Figure 3. Mexico's Import Dependency for Main Feed Grains and Oilseed Meals, 1990-97**



## Feed Grains

Grains and their subproducts are the main inputs to Mexican commercial feed mills and VIL operations. In the typical feed mix, these products constitute 71 percent of the volume of the industry's intermediate inputs and 27 percent of the cost. In 1993, for example, the industry used at least 3.48 million tons of grains and their subproducts, at a cost of US\$613.3 million (INEGI, 1994).

**Maize** According to INEGI (1994) Maize and its subproducts constitute 14 percent of the volume and represent 10 percent of the cost for the typical feed mix. INEGI reports that, in 1993 the industry used 707 thousand tons of maize and its subproducts, at a cost of US\$170 million. However, given the pervasive use of maize as feed in backyard operations, INEGI's figures are, no doubt, lower bounds on the volume and cost shares of maize and its products used as feed.

Table 1 shows Mexico's sources and use of maize since 1990. Domestic production has been remarkably stable, in spite of the significant drop in domestic prices since 1994, but the

country's apparent utilization has risen sharply.<sup>4</sup> The increasing deficit has been supplied by imports, which have undoubtedly risen as a result of the North American Free Trade Agreement (NAFTA). Imports averaged 3.6 million annually in the last three years, compared with 2.3 million in the first three years of the decade.

**Table 1. Mexico's Domestic Production and Imports of Maize (Whole and Broken), 1990-97**

	1990	1991	1992	1993	1994	1995	1996	1997
	<i>Thousand Metric Tons</i>							
Imp broken	37	39	351	323	280	68	82	63
Imp whole	4,089	1,398	1,283	163	2,710	2,636	5,818	2,469
Production	14,635	14,252	16,929	18,125	18,236	18,353	18,026	18,779

Source: Bancomext, INEGI, SAGAR

The strength of the link between imports of maize and the domestic feed industry can be assessed by regressing the volume of imports of maize and its subproducts against the volumes of feed produced commercially and by VIL operations. Results from a regression that considers the 1990 to 1997 period do not suggest a strong link between imports of whole maize and the feed industry (see Table 2). However, they do indicate a strong link between imports of broken maize and volumes feed produced commercially, and between imports of maize gluten and feed produced both by commercial and by VIL operations. The estimated parameter for each independent variable indicates the expected increase in the volume of imports (in tons) associated with every additional ton of feed produced in any given year.<sup>5</sup>

**Table 2. Imports of Maize and Maize Products as Linear Functions of Feed Produced Commercially and by Vertically-Integrated Livestock Operations, 1990-97**

<i>Product/Parameter values</i>	<i>Constant</i>	<i>Commercial</i>	<i>Integrated</i>	<i>R<sup>2</sup></i>
Maize	10,910	-3.290	0.472	
"t" values	** (6.90)	(-1.78)	(0.87)	0.42
Broken maize	-1,075	0.352	-0.015	
"t" values	** (-12.06)	** (3.39)	(-0.50)	0.70
Maize gluten	-63	0.030	0.007	
"t" values	(-0.15)	** (4.78)	** (3.53)	0.89

\*\* = coefficient is significant at  $\alpha = 0.01$ .

<sup>4</sup> The growth can be attributed in part to the drop in prices, in part to a higher per-capita consumption—the result of the drop in the population's purchasing power of higher-priced foods brought about by the economic crisis—and in part to the growth of the country's population.

<sup>5</sup> In interpreting the coefficients, the reader should keep in mind that many products are processed before they are incorporated to feed mixes, and lose part of their volume in the process. The reader should also keep in mind that official data on volume of feed produced are surely underestimates of actual volumes, and therefore reflect only part of the derived demand for grains and oilseeds from the feed industry.

Notwithstanding the lack of a strong link between imports of whole maize and domestic feed production suggested by this regression analysis, there is evidence that, at least recently, a significant share of imports of maize has been utilized as feed, and that the share will rise in the future. According to Canacindra (1998b), out of total whole maize imports carried out in 1997 within the NAFTA quota (2.5 million tons), 21 percent (514.8 thousand tons) were assigned to livestock producers or to the commercial feed industry. For 1998, 1 million tons, roughly 40 percent of the NAFTA quota, have been pre-assigned to both of these users.

**Sorghum** Sorghum is by far the main input in the Mexican feed industry by volume and by value. According to INEGI (1994), sorghum constitutes 50 percent of the volume of intermediate inputs and 24 percent of their cost in the typical feed mix. In 1993, the industry purchased 2.437 million tons of sorghum, at a cost of US\$377 million. Roughly 20 percent of the sorghum is used by commercial feed producers; the remaining 80 percent is used by VIL producers (ASERCA, 1997d).\*

Mexico is the major sorghum importer globally. On average, from 1992 to 1996, its imports constituted 41 percent of total world imports. However, as shown in Table 3, the country's domestic production has been increasingly able to supply the domestic market, as its falling trend during the three years of the decade have reverted to a sharply-rising one starting in 1994. Today, sorghum imports represent only a fourth of domestic apparent use, compared with an average 40 percent during the first three years of the decade.

**Table 3. Mexico's Domestic Production and Imports of Sorghum, 1990-97**

	1990	1991	1992	1993	1994	1995	1996	1997
	<i>Thousand Metric Tons</i>							
Imports	2,861	3,200	4,727	3,745	3,473	2,092	1,983	2,189
Production	5,978	4,308	5,353	2,581	3,701	4,170	6,610	5,490

Source: Bancomext, INEGI, SAGAR.

The strength of the link between sorghum imports and the domestic feed industry can be assessed by regressing the volume of imports against the volumes of feed produced. The results suggest a very strong link between imports of sorghum, and the volume of feed produced by commercial operations (see Table 4). The estimated parameter for each independent variable indicates the expected increase in the volume of imports (in tons) associated with every additional ton of feed produced at any given year. Since sorghum is not processed in any way that reduces its volume, we would have expected the estimated parameters to have values that are less than 1.0. A plausible explanation for the large ( $> 1$ ) coefficient associated with commercial feed volumes and the negative coefficient associated with volumes produced by VIL operations is that the VIL operations purchase imported sorghum from commercial operations as their sorghum requirements increase. (See also footnote 5.)

\* Editor's note: For an explanation of ASERCA see page 13.

**Table 4. Imports of Sorghum as a Linear Function of Feed Produced Commercially and by Vertically-Integrated Livestock Operations, 1990-97**

<i>Product/Parameter values</i>	<i>Constant</i>	<i>Commercial</i>	<i>Integrated</i>	<i>R<sup>2</sup></i>
Sorghum	-502	2.060	-0.473	
“t” values	(-0.86)	**(3.02)	(-2.37)	0.73

\*\* = coefficients are significant at  $\alpha = 0.01$ .

**Wheat** According to INEGI (1994), wheat and its products constitute 7 percent of the volume of intermediate inputs and 3 percent of their cost in the typical feed mix. In 1993, the industry purchased 326 thousand tons of these products, at a cost of US\$49 million.

Mexican millers classify wheats into five groups, based on its gluten properties. Groups I and II are soft wheats, used for bread-making, and groups III to V are used in the cookie and pasta industries, and are preferred as feed due to their lower price.<sup>6</sup> In Mexico, since the early 1990s there has been a drastic shift toward the production of the harder wheats in groups III to V. This shift has been due to problems with Karnal Bunt in bread wheats. While in 1993 wheats in groups III to V comprised 53 percent of production, their share had risen to 69 percent by 1996. As a result of this shift in output mix, the domestic demand for soft wheats has been increasingly satisfied by imports, which have tripled since 1991, and the domestic surplus of hard wheats has resulted in substantial exports. In 1995, exports of durum were boosted to a record 453 thousand tons by a devalued peso and a low supply of hard red Winter wheats in the U.S. Exports averaged 100 thousand tons in the last two years (ASERCA, 1997f). Figure 4, shows the evolution of domestic production and imports since 1990. The drop in domestic production since 1994 combined with a rise in demand has resulted in a shift from a situation of practical self-sufficiency at the beginning of the decade, to one in which a third of domestic consumption is supplied by imports.

The strength of the link between wheat imports and the domestic feed industry is assessed by regressing the volume of imports against the volumes of feed produced. Results in Table 5 suggest that VIL producers are important buyers of imported wheat. They will likely buy 495 additional kilos of imported wheat for every additional ton of feed that they produce.

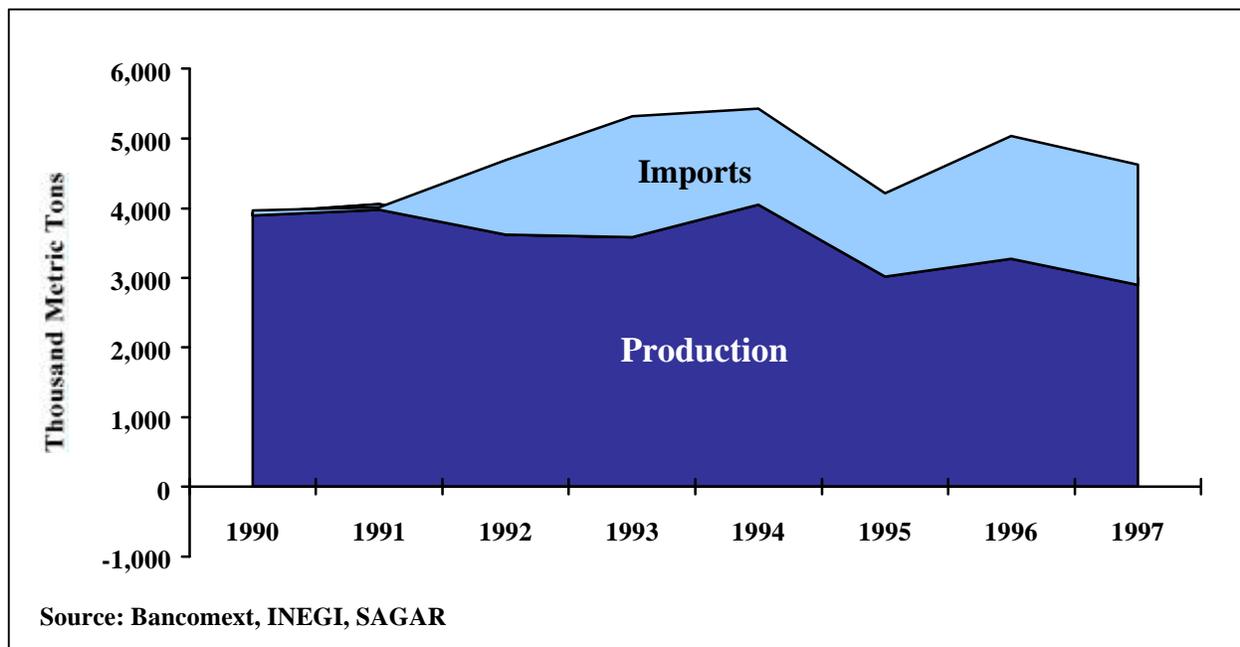
**Table 5. Imports of Wheat as a Linear Function of Feed Produced Commercially and by Vertically-Integrated Livestock Operations, 1990-97**

<i>Product/Parameter values</i>	<i>Constant</i>	<i>Commercial</i>	<i>Integrated</i>	<i>R<sup>2</sup></i>
Wheat	-5,525	0.496	0.495	
“t” values	**(-11.83)	(0.91)	**(3.11)	0.69

\*\* = coefficients are significant at  $\alpha = 0.01$ .

<sup>6</sup> In 1996, for example, bread wheats sold at a premium of 20 to 25 percent over durums.

**Figure 4. Mexico's Domestic Production and Imports of Wheat (Whole and Broken), 1990-97**



### Oilseeds and Subproducts

Oilseeds and their subproducts are also major inputs for the industry. According to INEGI (1994), they constitute 14 percent of the volume and 27 percent of the cost of the typical feed mix. In 1993, the industry purchased 696 thousand tons of oilseeds and their products, at a cost of US\$382.4 million, mostly from imports.

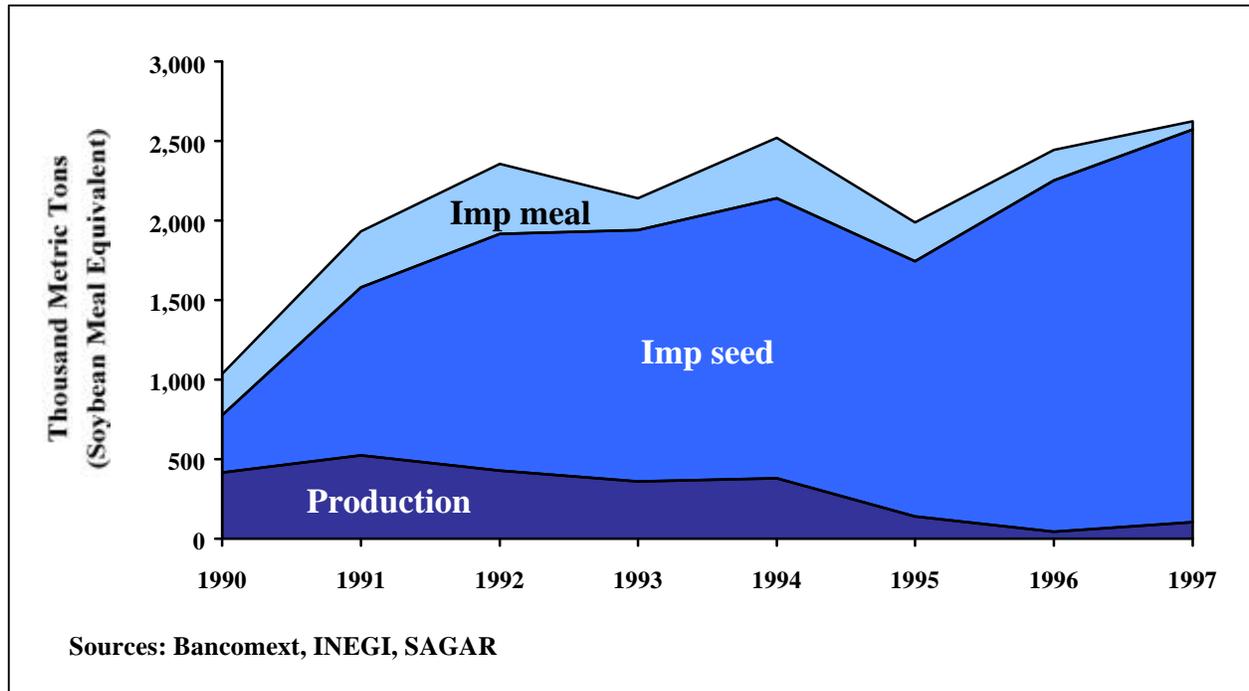
**Soybeans and Soybean Meal** Soybeans and soybean products are the second most important input in the Mexican Feed industry after sorghum, and by far the main oilseed ingredient. According to INEGI (1994), soybeans and its subproducts (meal and oil) constitute 14 percent of the volume and 22 percent of the cost of the typical feed mix. In 1993, the industry bought 682 thousand tons of these products, at a cost of US\$347 million.

As shown in Figure 5, Mexico's soybean production has fallen significantly during the 1990s. Harvested surfaces and yields have been reduced drastically due the combined effects of water scarcity in the Northwest, white fly infestations, and a drop in real prices. Domestic apparent use (in soybean meal equivalent), which has risen by an average 14 percent annually since 1990, has been increasingly supplied by imports of soybeans and soybean meal. The country's dependency on imports of both products has gone from 60 percent in 1990 to 97 percent in the period 1996-97. Today, soybeans constitute 73 percent of the value of total Mexican oilseed and oilseed product imports (ASERCA, 1997a). The fact that most soybeans are imported whole, increasingly so in the post-NAFTA years, is probably due to the lower tariff on whole soybeans than on meal.

The link between soybean and soybean meal imports, and the domestic feed industry suggests that the strongest links lie with whole soybean imports, from demand by VIL producers

(see Table 6). The coefficients suggest that each additional ton of feed produced by VIL operations is associated with 725 kilos of additional soybean imports, or 468 additional kilos of meal imported either as whole soybeans or as meal.

**Figure 5. Mexico's Domestic Production and Imports of Soybeans and Soybean Meal, 1990-97**



**Table 6. Imports of Soybeans and Soybean Meal as Linear Functions of Feed Produced Commercially and by Vertically-Integrated Livestock Operations, 1990-97**

<i>Product/Parameter values</i>	<i>Constant</i>	<i>Commercial</i>	<i>Integrated</i>	<i>R<sup>2</sup></i>
Soybeans	-5,925	0.304	0.725	
"t" values	**(-14.25)	(0.63)	** (5.11)	0.85
Soybean meal	44	0.213	-0.064	
"t" values	(0.47)	(1.92)	(-1.99)	0.58
Soybeans + meal (meal equivalent)	-4,217	0.408	0.468	
"t" values	**(-14.12)	(1.17)	** (4.59)	0.83

\*\* = coefficients are significant at  $\alpha = 0.01$ .

**Cottonseed and Cottonseed Meal** According to INEGI (1994), cottonseed and its subproducts (meal and oil) constitute 0.06 percent of the volume and 0.12 percent of the cost of the typical feed mix. The feed industry bought 2.8 thousand tons at a cost of US\$1.8 million in 1993. However, regression analysis conducted by the author for the period 1990 to 1997 suggests that INEGI's figures may be grossly underestimating the importance of cottonseed and meal as feed

ingredients. Results of the analysis, shown in Table 7, indicate that every additional ton of feed produced commercially has been associated with an additional 146 kilos of imports of cottonseed meal equivalent (imported either as cottonseed or cottonseed meal). These results not only suggest a relatively strong linkage between imports of these products and the domestic feed industry, but also establish a lower bound on their share in the volume of the typical feed mix that is much higher than the one suggested by INEGI.

**Table 7. Imports of Cottonseed and Cottonseed Meal as Linear Functions of Feed Produced Commercially and by Vertically-Integrated Livestock Operations, 1990-97**

<i>Product/Parameter values</i>	<i>Constant</i>	<i>Commercial</i>	<i>Integrated</i>	<i>R<sup>2</sup></i>
Cottonseed	-479	0.212	-0.027	
“t” values	**(-12.47)	** (4.73)	(-2.04)	0.83
Cottonseed meal	-155	0.054	0.001	
“t” values	**(-9.29)	(2.79)	(0.13)	0.61
Cottonseed + meal (meal equivalent)	-361	0.146	-0.011	
“t” values	**(-11.57)	** (4.00)	(-1.01)	0.77

\*\* = coefficients are significant at  $\alpha = 0.01$ .

The drastic changes in domestic cotton production, which have resulted in an equally unstable domestic production of cottonseed, explain the high variability of cottonseed imports. The degree of dependency on imports of both products has shifted significantly during the 1990s, from 39 percent in 1990, up to 94 percent in 1992, and down again to 36 percent during 1996 and 1997. Imports were reduced to almost zero in 1996 and 1997 due to the boom in domestic cotton production that began in 1994 as a result of favorable world prices. Compared to cottonseed imports, those of cottonseed meal have remained relatively stable.

***Other Oilseeds and Oilseed Meals (Canola, Safflower, Linseed, Sesame)*** According to INEGI (1994), other oilseeds and oilseed meals constitute 2.6 percent of the cost of the typical feed mix. The industry spent US\$40 million on purchases of these products in 1993. Domestic apparent use, although highly variable, has grown at an average 10 percent annually since 1990. Although the downward trend in domestic production during the early years of this decade reverted to an ascending one since 1995, domestic demand has been increasingly satisfied by imports. In 1997, 69 percent of the domestic consumption of these oilseed meals was supplied by imports. Due to tariff escalation, almost all imports were in the form of seed, instead of meal.

Regression analysis conducted by the author for the period 1990 to 1997 suggests that the links between imports of these other oilseeds and the feed industry are relatively weak (Table 8). The results suggest that the demand for imports may be coming mainly from the food sector. Within the feed industry, commercial operations seem to be the main users.

**Table 8. Imports of Other Oilseeds and Oilseed Meal as Linear Functions of Feed Produced Commercially and by Vertically-Integrated Livestock Operations, 1990-97**

<i>Product/Parameter values</i>	<i>Constant</i>	<i>Commercial</i>	<i>Integrated</i>	<i>R<sup>2</sup></i>
Canola seed	-1,821	0.295	0.091	
“t” values	**(-14.50)	(2.01)	(2.12)	0.65
Other oilseed seed meals	-105	0.023	0.003	
“t” values	**(-10.78)	(2.02)	(0.92)	0.52
Other oilseeds + meal (meal equivalent)	-1,198	0.200	0.058	
“t” values	**(-16.78)	(2.40)	(2.36)	0.71

\*\* = coefficients are significant at  $\alpha = 0.01$ .

## AGRICULTURAL POLICIES

Recent changes in policy, geared towards a greater role of markets and improved productivity, are affecting the supply and demand of grains and oilseeds. Following is a brief description of the main programs and policies.

### **Alianza para el Campo**<sup>7</sup>

The Alianza para el Campo support program was negotiated with producers in October 1995, with the main goal of increasing the agricultural sector's productivity. The program started operating in the first months of 1996. It is cofinanced by the Federal government, which contributes 32 percent of the cost; state governments that furnish 18 percent; and producers, who provide the remaining 50 percent of the funds. Funds are deposited in ad hoc state trust funds (FOFAE). The twenty-three specific programs of Alianza para el Campo, which operated during 1996, had increased to more than 50 by the end of 1997.

Each FOFAE is managed by a Technical Committee, according to rules of operation established in the technical specifications for each specific program. Programs are decentralized so that their operation is coordinated by the Mexican Ministry of Agriculture (SAGAR) regional offices (DDRs), along with state governments. Producers can finance the programs either through their own resources, through credit, or through the transfer of their rights to future PROCAMPO payments.<sup>8</sup> The total cost of the program in 1996, including producers' contributions, amounted to 3.764 billion pesos (US\$495 million), and, according to Ministry of Agriculture (SAGAR) estimates, it benefited 2.1 million producers that year. The specific programs within Alianza para el Campo that have affected the grain-livestock subsector most directly are those to promote mechanization, oilseed production, and the purchase of improved maize seeds. Each of these programs is described briefly below:

<sup>7</sup> “Alianza para el Campo” means, literally, alliance for the countryside.

<sup>8</sup> See next section for an explanation of PROCAMPO.

The program to promote mechanization includes discounts on the purchase of agricultural tractors and precision drills produced domestically, and a subsidy by Federal and state governments on the purchase price. Producers under this program end up purchasing a new tractor or precision drill at roughly half the price of similar imported machinery. The program also includes a subsidy on the purchase of spare parts to repair old machinery. SAGAR (1996) estimated that by the end of 1996, 11,176 tractors and 729 precision drills were bought or repaired under the program. Federal and state government spending by the end of 1996 amounted to 206 million pesos (US\$27 million), and is estimated at 230 million pesos (US\$29 million) for 1997, to support the purchase or repair of 10,185 tractors and 1,850 precision drills. SAGAR (1997c) estimates that the mechanization program increased maize production by 1.2 million tons in 1996.

The goal of the oilseed program is to reduce Mexico's chronic high dependency on imports of vegetable oils. The program supports the establishment of oil palm and coconut palm plantations in Mexico's Southwest. Support for oil palm includes annual per-hectare payments for nurseries and plantations. Support for coconut includes a one-time per-hectare payment for "mother" plantations and nurseries, and an annual per-hectare payment for plantations. The program plans to establish 30,000 hectares of oil palm in the states of Chiapas, Tabasco, Veracruz and Campeche, which could start producing up to 10,500 tons of oil annually within the next decade. Federal and state government spending by the end of 1996 amounted to 34 million pesos (US\$4.5 million), 77 percent of the total cost of the program. The estimate for 1997 is 53 million pesos (US\$6.7 million). This program will surely benefit domestic consumers of vegetable oil, but its effects on the feed industry are uncertain. Since the production of traditional oilseed crops is likely to be further reduced by the competition of coconut and oil palm, feed producers will likely be forced to import greater amounts of oilseed meal.

The program to promote the use of improved maize (plus bean and rice) seeds is called "kilo por kilo" (a kilo for a kilo) because it consists on the sale of a kilo of improved seed to the producer, at the ongoing market price of a kilo of grain from the producer's own harvest. The program has been implemented in most of the country, with the exception of highly technified areas in which the use of improved seed is already generalized. SAGAR estimates that 270 thousand hectares of maize and beans were planted during the 1996 crop year under this program, with 7 thousand tons of improved seed. Federal and state government expenditures on this program during 1996 reached 45.1 million pesos (US\$5.9 million). Government expenditures increased to an estimated 153 million pesos (US\$19 million) in 1997, to distribute 15,600 tons of improved seed that benefited 565,257 hectares. (SAGAR, 1996 and 1997). According to SAGAR's (1997c) estimates, the program increased maize production by 412 thousand tons in 1996.

### **The PROCAMPO Program\***

PROCAMPO's direct payments to approximately 3 million producers covered roughly 14.1 million hectares in the 1997 crop year, at a total cost that year of 7.139 billion pesos (US\$917 million). Four hundred and eighty-four pesos per hectare were paid for the 1996-97 Fall-Winter cycle and 556 pesos for the 1997-97 Spring-Summer cycle (SAGAR, 1996). Criteria

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\* Editor's note: See Yunez-Naude, 1997 pgs 64-65 for an explanation of the PROCAMPO Program.

for PROCAMPO's eligible surface have been made more flexible. Eligible surface in the original producer directory must be cultivated each cycle, or be dedicated to livestock production, or forestry, or an "environmental" program.

Producers can now use their future PROCAMPO payments as credit guarantees. They can also transfer their rights to PROCAMPO payments to input distributors, banks, credit unions, producer organizations, state governments, and government offices against the delivery of goods or services. Such transfers to acquire working capital and inputs has become increasingly popular among producers as an instrument to ease cash constraints. In the 1997 crop year, for example, 759 thousand producers, with 17 percent of the area under PROCAMPO, ceded their rights to future PROCAMPO payments in this manner (SAGAR, 1997a).

### **CONASUPO and ASERCA**

CONASUPO, the long-lived Mexican marketing parastatal, remains the buyer of last resort of maize and beans at a "support" price. Up to 1994, CONASUPO was a major buyer of maize. For example, in the 1993 and 1994 crop years, CONASUPO bought 45 percent of the domestic harvest. The parastatal was consequently a major supplier to Diconsa, the milling, starch and feed industries, and even to livestock producers. Starting in August, 1995 cycle, the panterritorial price of maize paid by CONASUPO was substituted by a regional "support" price system, consisting of a "base" price, plus a fixed transport and handling adjustment, plus a regional "marketing" factor, plus a quality adjustment. Since the "support" price is now set at below market price levels in most regions, CONASUPO's participation in the market has dropped significantly. By the end of 1995, the agency's participation as a buyer of maize had dropped to 19 percent, and by the end of 1996 to roughly 8 percent (SAGAR, 1997c).

CONASUPO also operates a system of non-recourse loans whereby producers store the grain with CONASUPO against which CONASUPO advances 70 percent of the crop's value at the "support" price. The producer has at most three months to redeem his warehouse receipt, pay CONASUPO back and sell the product in the market, or leave the crop with CONASUPO and obtain the rest of the payment.

ASERCA, another government marketing support agency, operates a series of marketing support systems designed ad hoc for individual grains and oilseeds. For example, it gives direct payments to cotton producers to cover post-harvest fumigation costs. To promote domestic soybean production and the immediate marketing of the domestic harvest, ASERCA compensates wholesale soybean buyers for the difference between the price of imported soybeans and a higher "agreement" price that they pay to domestic producers. The agency operated a similar system of "agreement" prices for wheat from 1991 to 1995 (ASERCA, 1997e). To reduce water consumption, ASERCA offers direct payments (additional to those of PROCAMPO) to producers that grow safflower instead of wheat or maize. And during the 1996-97 Fall-Winter cycle ASERCA compensated domestic buyers of sorghum produced in Tamaulipas, Nuevo León and Sinaloa, located in Jalisco or Nayarit, for the payment of high "agreement" prices to producers (Canacindra, 1997a).

Finally, ASERCA, jointly with the Ministries of Finance and Agriculture, operates a put-options program to reduce the price risk in the marketing of maize, wheat, sorghum, soybeans

and cotton. The program effectively establishes a price floor for producers while maintaining their ability to sell at the market price when it is higher than the strike price established in the put-option contract. ASERCA pays part or the whole of the option premium, depending on the modality of the program chosen by the producer.

## **PROFITABILITY OF FEED GRAINS AND OILSEEDS**

FIRA, a development bank that specializes in lending to commercial agricultural producers, undertakes periodic surveys of its clients to assess costs of production, producer prices and the profitability of basic grains and oilseeds. Because costs are calculated using a uniform methodology, FIRA's surveys can be used to monitor and compare the competitiveness of these crops grown under different water regimes—rainfed, reservoir irrigated and ground water-irrigated—across states, and across years. Although FIRA's surveys are not necessarily representative of the spectrum of commercial production systems in the country, they are the best systematic data set available for this purpose. A summary for the last two published surveys, for 1994-94 and the 1996-96 Spring-Summer cycles,<sup>\*</sup> is presented below for the main feed grains (maize and sorghum) and oilseeds (soybeans and cottonseed).<sup>9</sup>

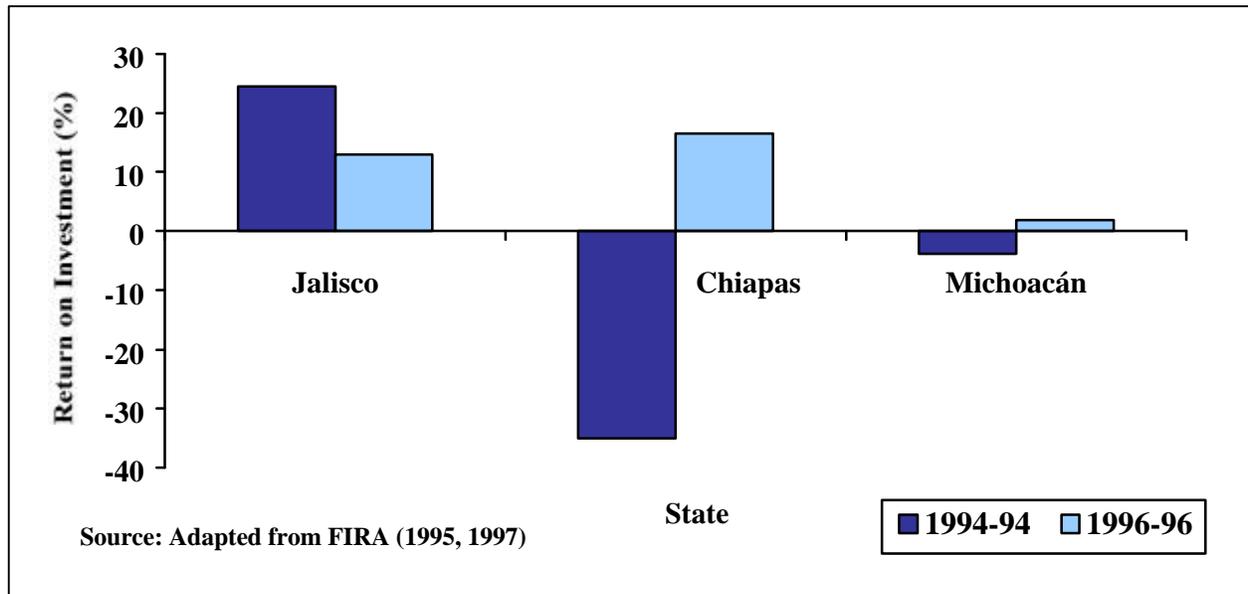
**Maize** The profitability of maize, measured as the percent return on investment for commercial maize producers, ranged from -35 percent to 65 percent in 1994-94 and from -3 percent to 85 percent in 1996-96. From 1994-94 to 1996-96, the profitability of maize improved in most production systems and states (see Figures 6 to 8). Profitability improved in rainfed maize in Jalisco, Chiapas and Michoacán; it also improved in reservoir-irrigated operations in Sinaloa, Chihuahua and Durango, but worsened in Michoacán; and it improved in groundwater-irrigated operations in Chihuahua, Durango, Zacatecas and Guanajuato.

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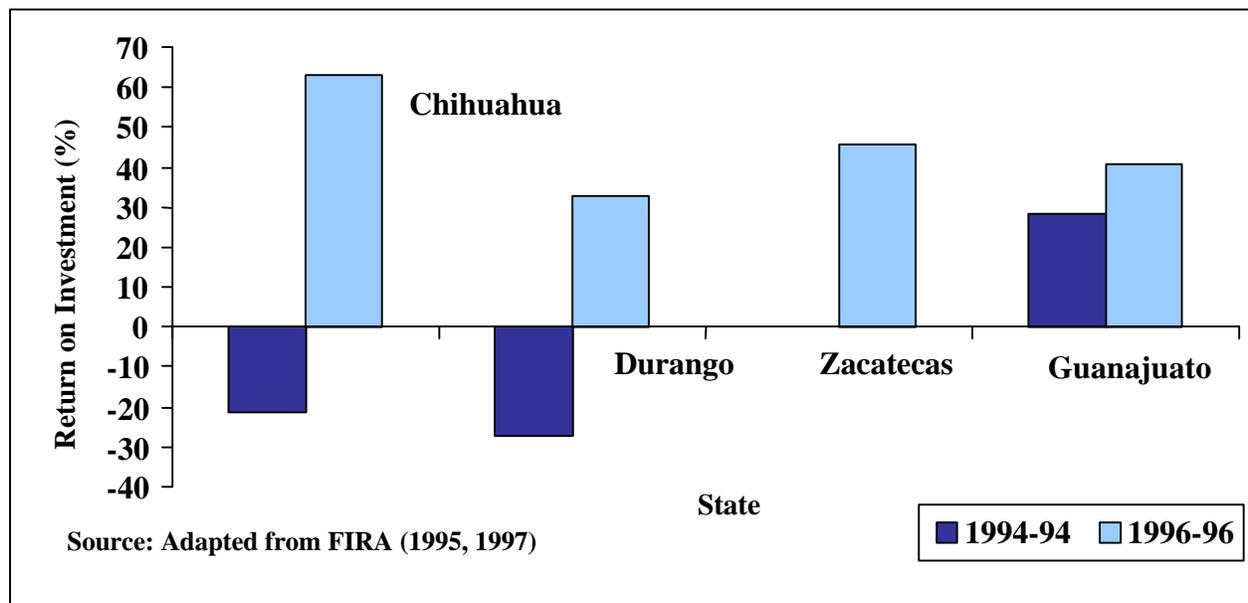
\* Author's note: The 1994-94 Spring-Summer crop cycle refers to the months from May 1994 to October 1994. The Fall-Winter crop cycle refers to the months from November 1994 to April 1995, similarly for other years.

<sup>9</sup> Wheat is not included in the analysis because it is grown mainly in the Fall/Winter cycle and was therefore not part of FIRA's published surveys.

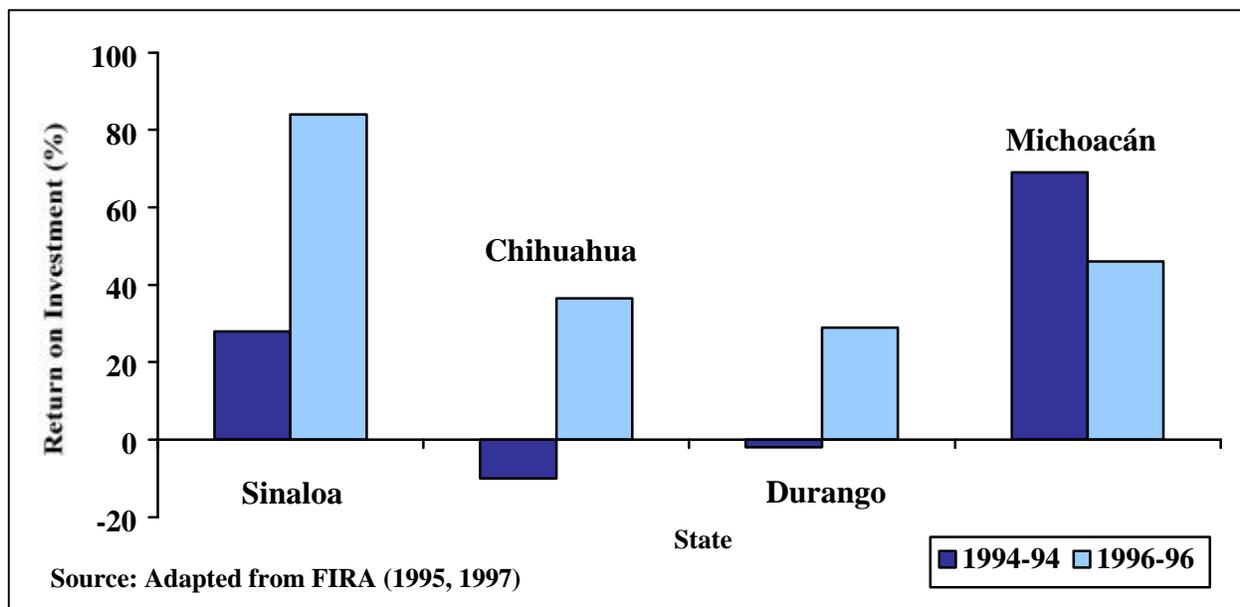
**Figure 6. Profitability of Maize Production in Main Producing States of Mexico, Rainfed, 1994-94 and 1996-96**



**Figure 7. Profitability of Maize Production in Main Producing States of Mexico, Groundwater-Irrigated, 1994-94 and 1996-96**

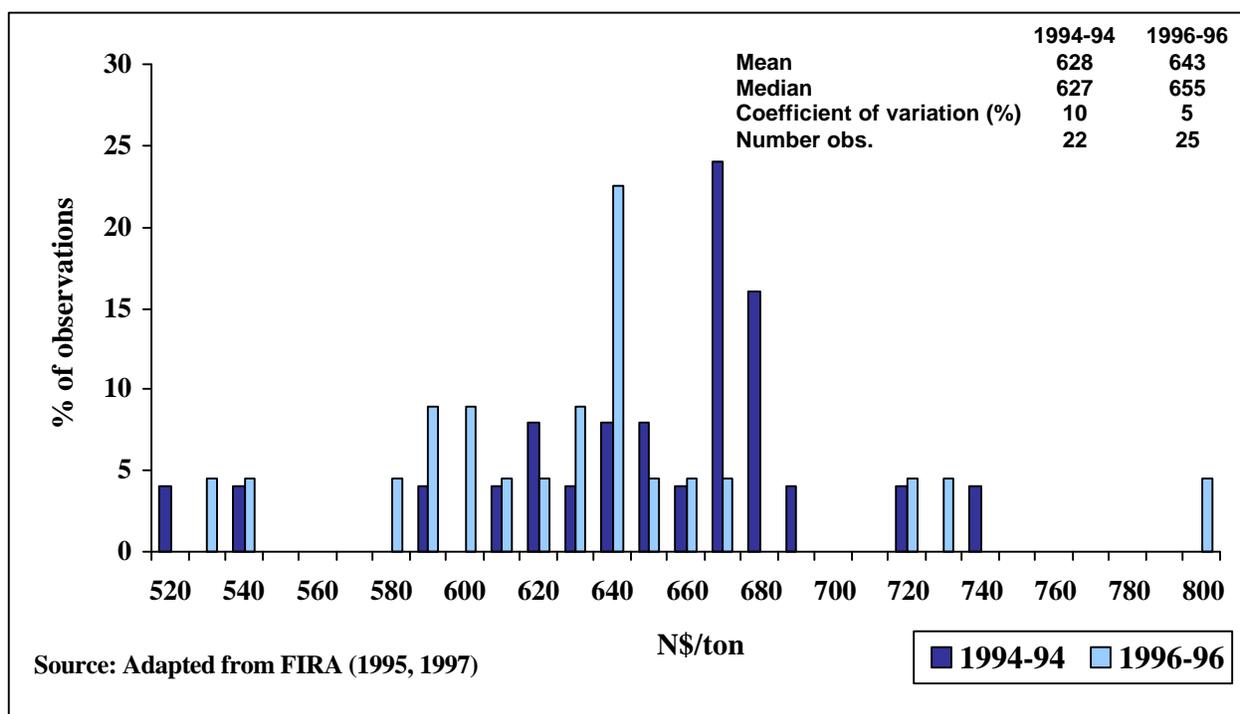


**Figure 8. Profitability of Maize Production in Main Producing States of Mexico, Reservoir-Irrigated, 1994-94 and 1996-96**

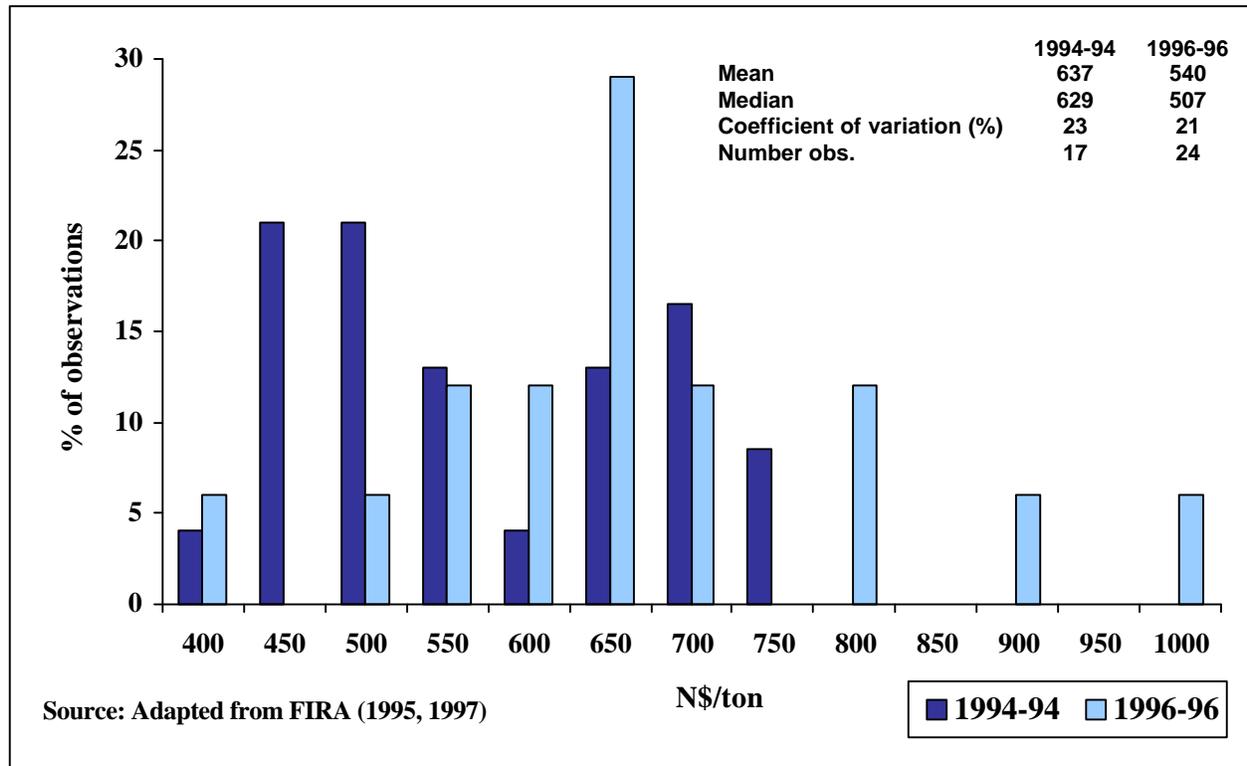


Farmgate maize prices and costs per ton presented a significant spatial variation during both cycles (see Figures 9 and 10). The economic conditions faced by the average commercial maize producer improved from one cycle to the other, as average real prices rose slightly by 2 percent and real average production costs dropped by 15 percent.

**Figure 9. Spatial Distribution of Real (1994) Farmgate Maize Prices in Mexico, 1994-94 and 1996-96**



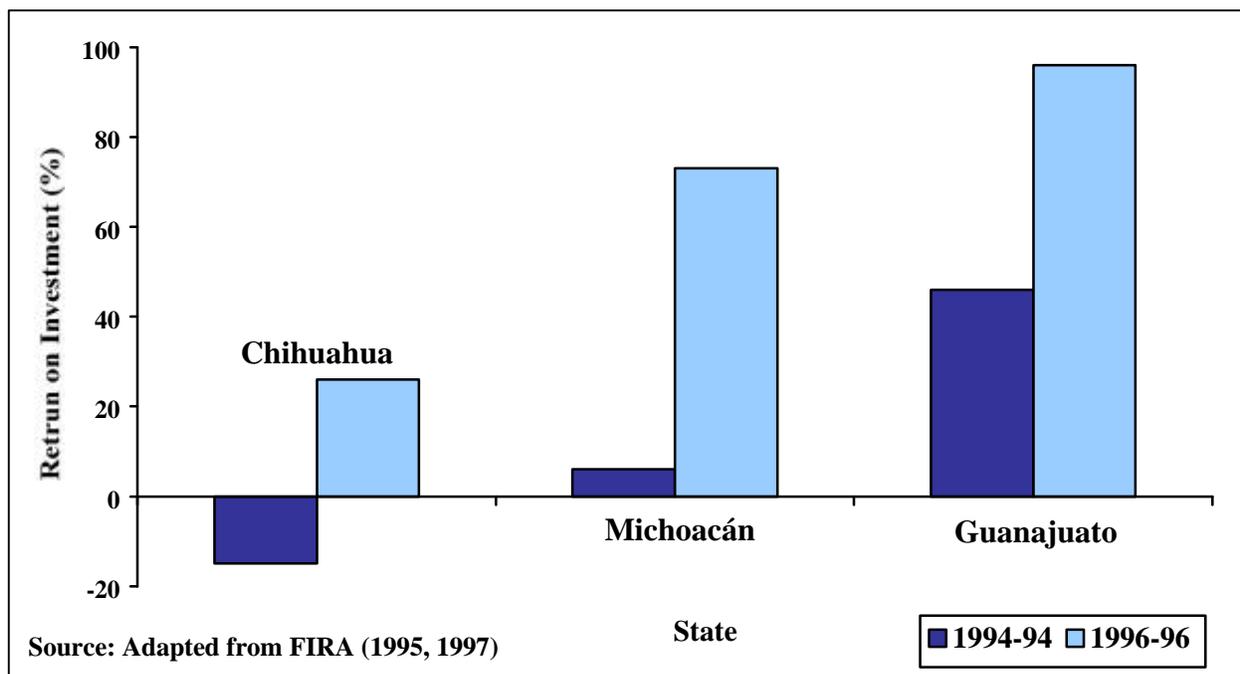
**Figure 10. Spatial Distribution of Real (1994) Production Costs of Maize in Mexico, 1994-94 and 1996-96**



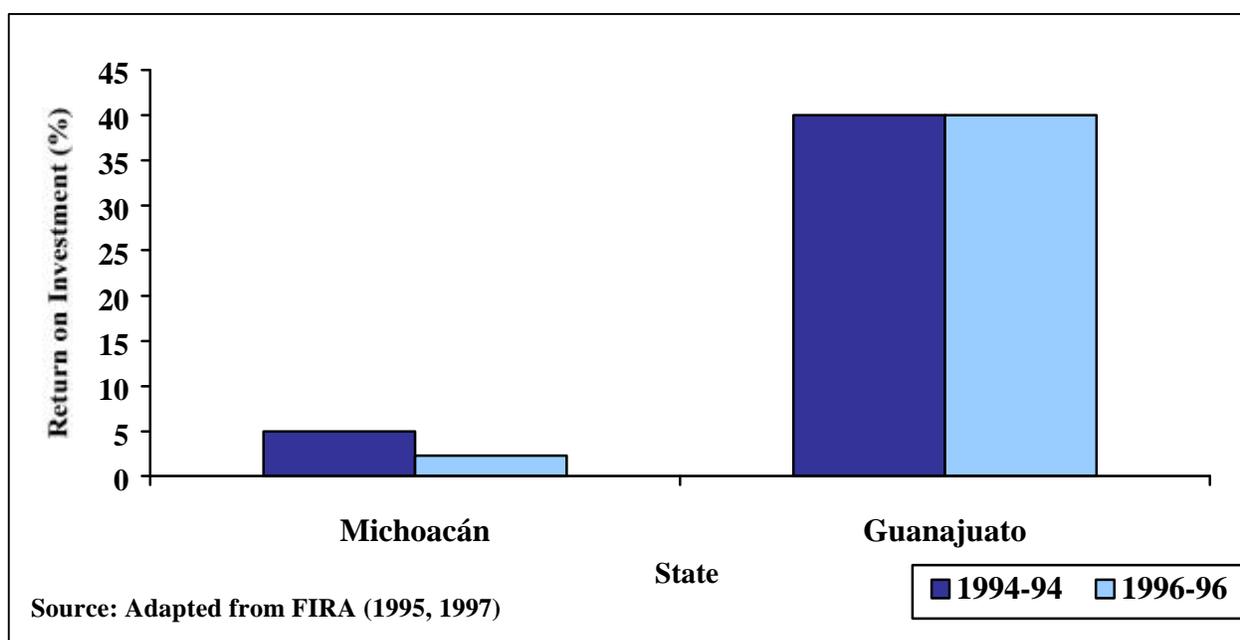
**Sorghum** Most of the sorghum is produced in Tamaulipas and the region in Mexico's central plateau known as the Bajío, mainly in Guanajuato, Jalisco and Michoacán. These four states cultivate roughly 80 percent of the area and produce 82 percent of domestic output. Two thirds of the sorghum area is cultivated under rainfed conditions.

The return on investment for commercial sorghum producers ranged from -20 to 45 percent in 1994-94 and from 2 percent to 95 percent in 1996-96. Profitability improved in most production systems and states surveyed in both years (see Figures 11 to 12). Profitability improved in reservoir-irrigated areas in Michoacán and Guanajuato, and in groundwater-irrigated operations in both of these states and in Chihuahua. However, while profitability in rainfed operations in Chiapas improved, rainfed production became unprofitable in Tamaulipas due to a drastic drop in yields as a result of the 1996 drought. Farmgate sorghum prices and costs per ton presented a significant spatial variation during both cycles (see Figures 13 and 14). The economic conditions faced by the average commercial sorghum producer improved as average real prices rose by 32 percent and real average production costs dropped by 5 percent.

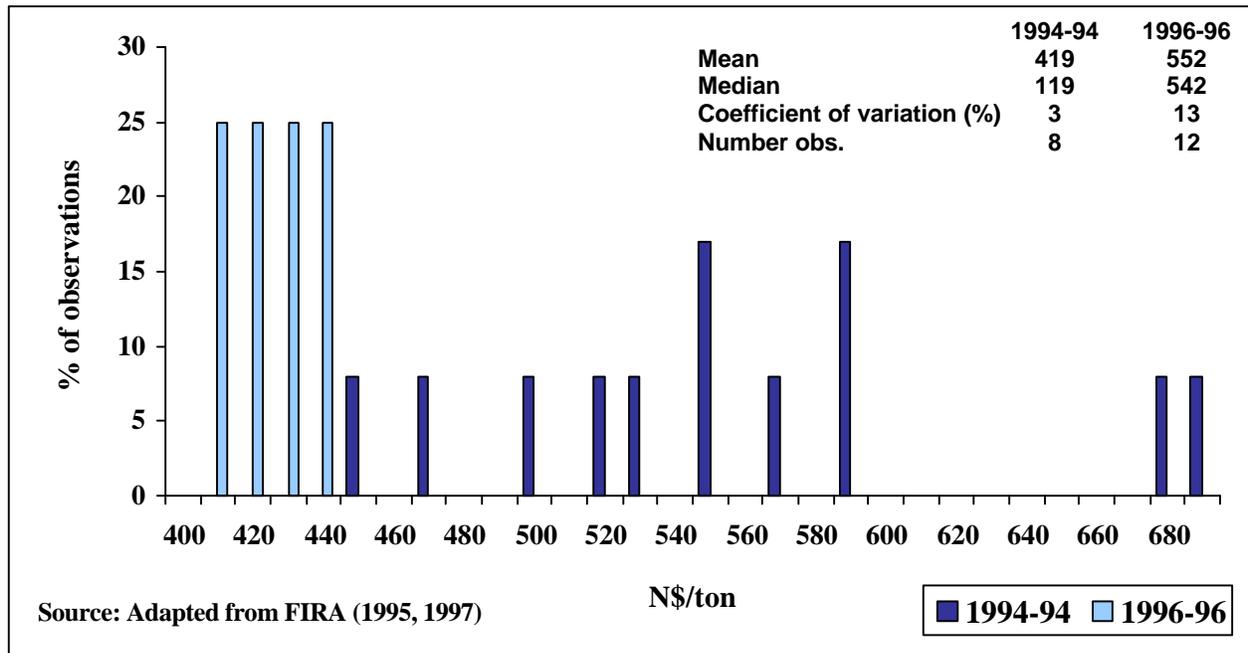
**Figure 11. Profitability of Sorghum Production in Main Producing States of Mexico, Groundwater-Irrigated, 1994-94 and 1996-96**



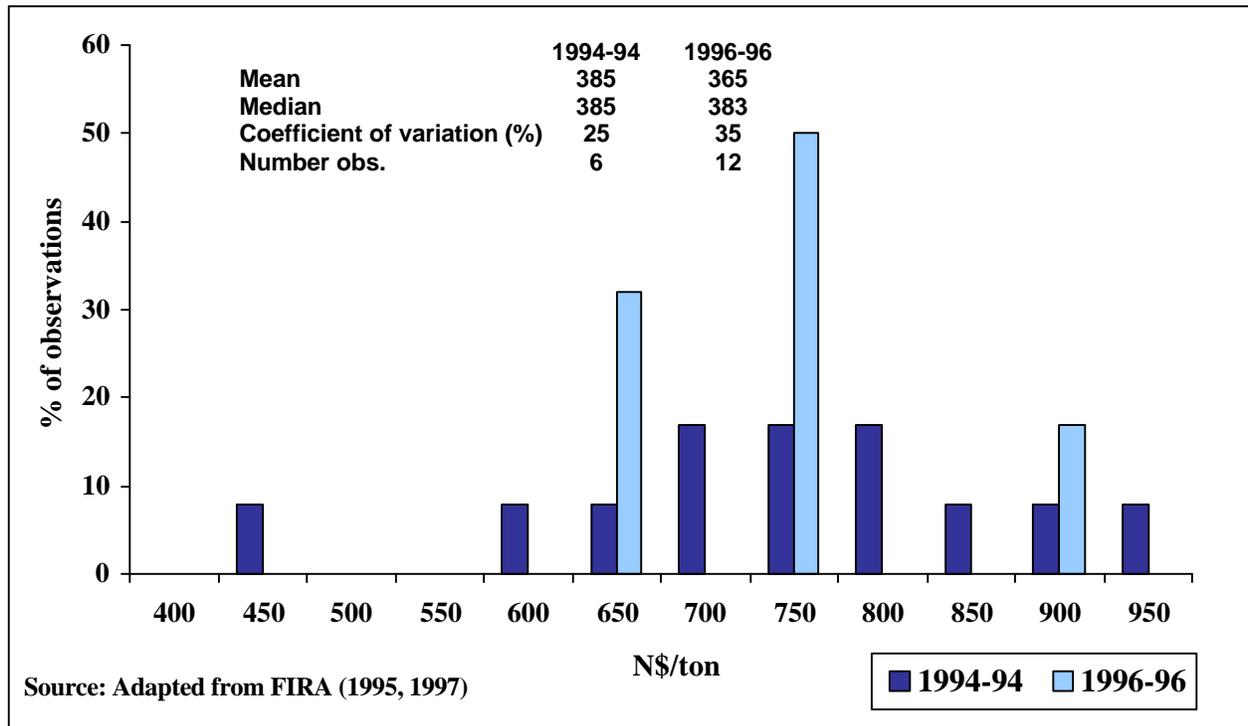
**Figure 12. Profitability of Sorghum Production in Main Producing States of Mexico, Reservoir-Irrigated, 1994-94 and 1996-96**



**Figure 13. Spatial Distribution of Real (1994) Farmgate Sorghum Prices in Mexico, 1994-94 and 1996-96**

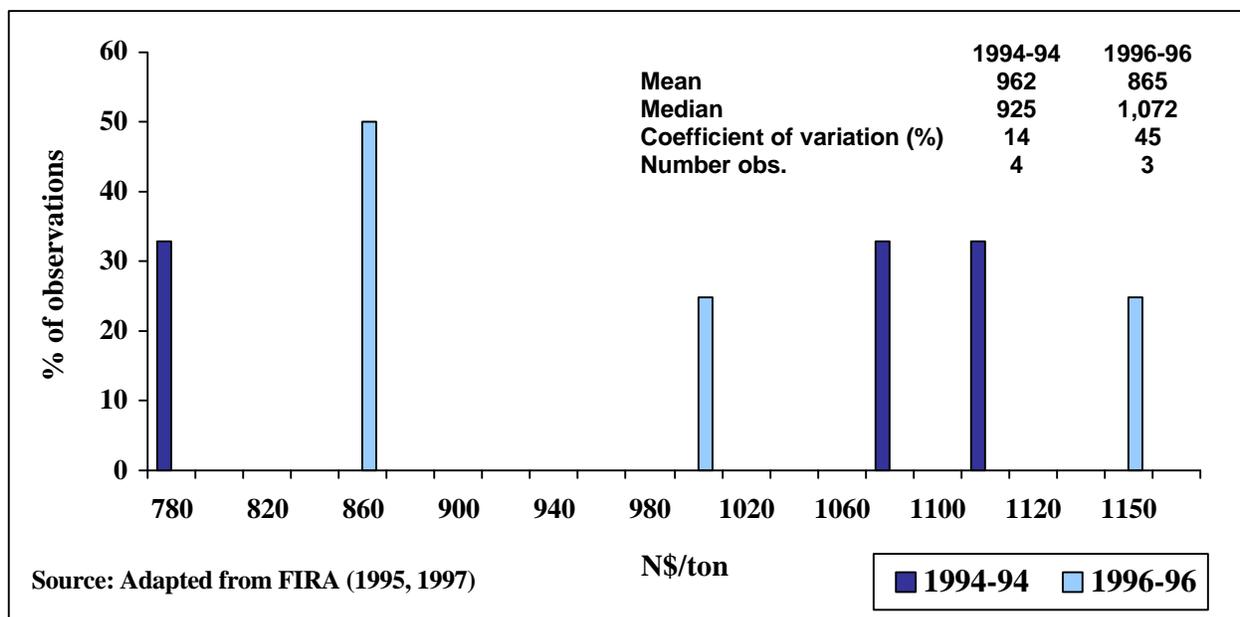


**Figure 14. Spatial Distribution of Real (1994) Production Costs of Sorghum in Mexico, 1994-94 and 1996-96**

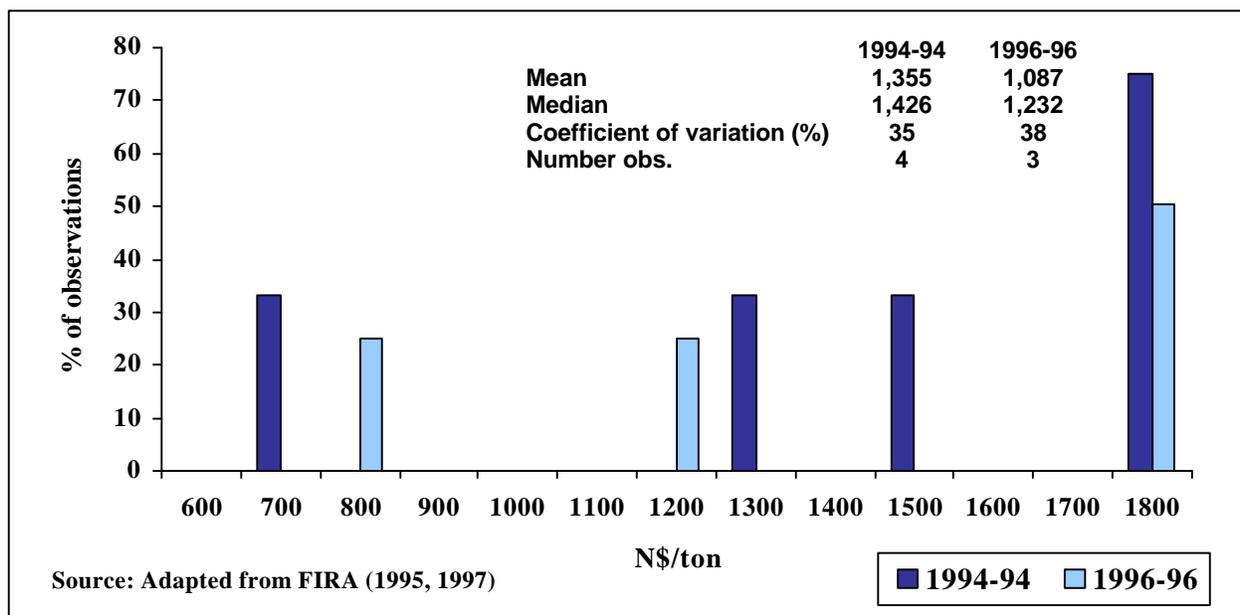


According to FIRA (1993, 1995, 1997) the profitability of soybean production went from an average of 28 percent in 1991 to -24 percent in 1994. By 1996 few farmers in Sinaloa and Sonora were receiving credit for soybean production from FIRA or any other bank. Profitability dropped for the average farmer, in spite of the 20 percent drop in real, average, per ton costs of production (see Figure 15), because of the combined effect of lower yields and a 10 percent drop in real, average farmgate prices (see Figure 16).

**Figure 15. Spatial Distribution of Real (1994) Farmgate Soybeans Prices in Mexico, 1994-94 and 1996-96**

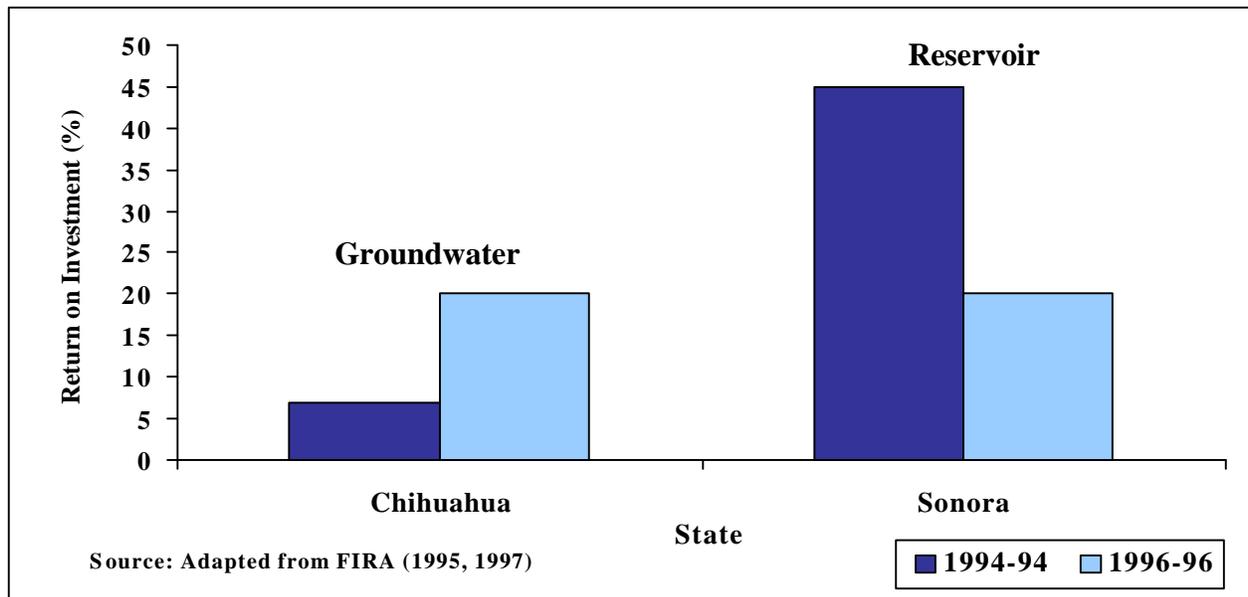


**Figure 16. Spatial Distribution of Real (1994) Production Costs of Soybeans in Mexico, 1994-94 and 1996-96**

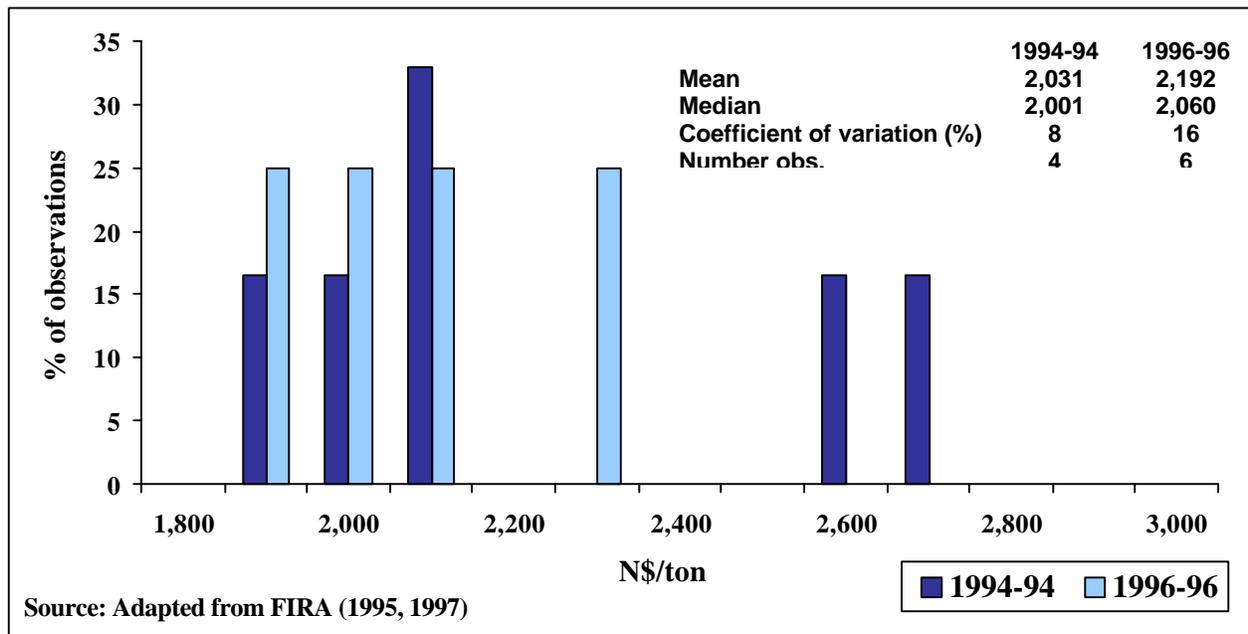


**Cotton** The return on investment for commercial cotton producers ranged from 6 percent to 45 percent in 1994-94 and averaged 20 percent 1996-96. The profitability of groundwater-irrigated cotton in Chihuahua improved. And although the profitability of cotton in Sonora, where it is mostly reservoir-irrigated, dropped between 1994-94 and 1996-96, it remained a highly profitable crop in this state (see Figure 17). Average, real production costs increased only 1 percent between the two periods, and average, real prices increased by 7 percent (see Figures 18 and 19).

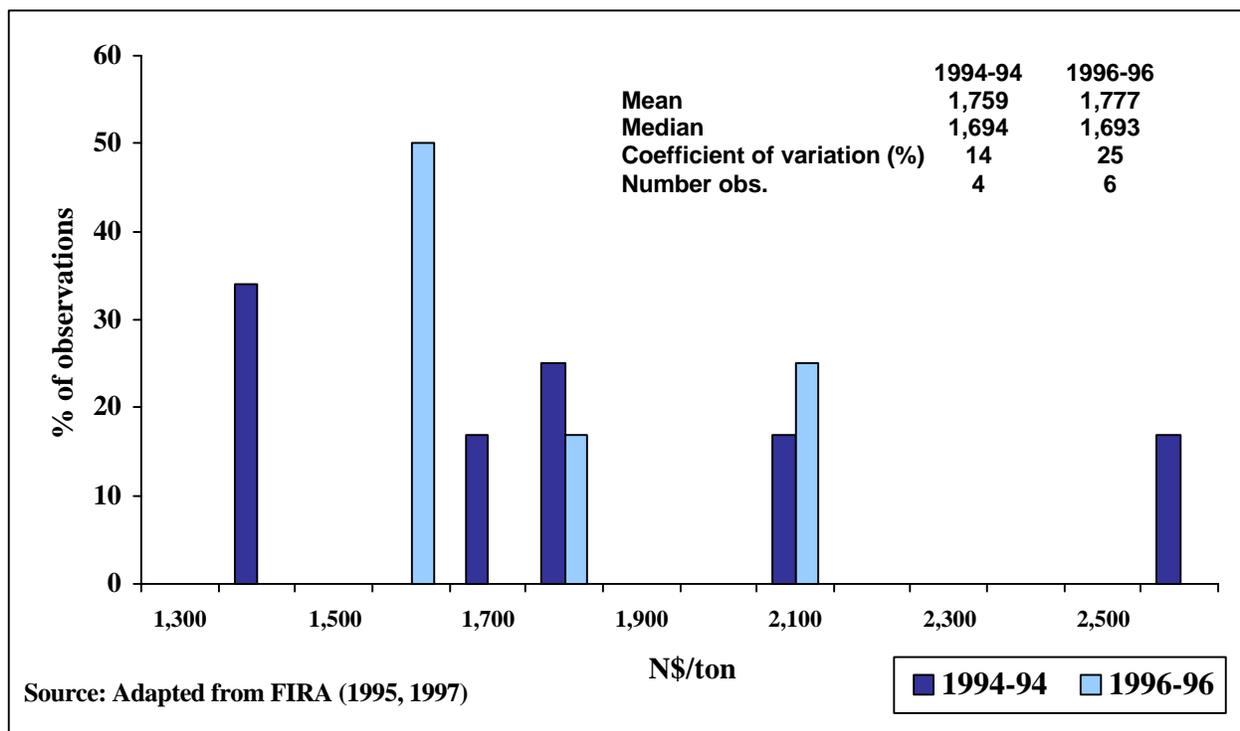
**Figure 17. Profitability of Cotton Production in Main Producing States of Mexico, Groundwater and Reservoir-Irrigated, 1994-94 and 1996-96**



**Figure 18. Spatial Distribution of Real (1994) Farmgate Seed Cotton Prices in Mexico, 1994-94 and 1996-96**



**Figure 19. Spatial Distribution of Real (1994) Production Costs of Seed Cotton in Mexico, 1994-94 and 1996-96**



## SUMMARY AND CONCLUSIONS

In spite of the recent economic crisis, Mexico has sustained a rapid growth in the consumption of livestock products during the 1990s, due both to an expanding population and to continued shifts in eating habits towards such products. The domestic production of livestock products has been stimulated by this dynamic growth in demand, which in turn, has motivated a fast expansion of the domestic demand for feed.

Besides its fast growth, the Mexican feed industry has experienced a drastic restructuring in the past decade and a half, as a result of the new free-market environment in the country, brought about by trade liberalization, the thinning of government intervention, and the recent economic crisis. In contrast with the feed industry's structure a decade ago, vertically-integrated livestock operations today predominate over commercial feed plants. Judging by the high idleness of the installed capacity of commercial operations, this trend is likely to continue in the future.

Although the domestic feed industry has grown fast enough to satisfy the domestic demand for feed, the industry has become increasingly dependent on imports to meet its requirements of grains and oilseeds. Over the last two years, imports have supplied a fifth of the domestic apparent consumption of sorghum, 98 percent of that for soybean meal (imported as whole soybeans or as meal), over a third of that for cottonseed meal (imported as whole

cottonseed or as meal), and over half of that for other oilseeds meals (imported as whole seeds or as meals). Results from regression analysis suggest that imports of broken maize, maize gluten, sorghum, wheat, whole soybeans and cotton seed present the strongest links with volumes produced by the domestic feed industry. And recent NAFTA quota allocations for whole maize indicate that the share of its imports destined for feed use is growing fast.

Recent changes in policy, geared towards a greater role of markets and improved productivity, are affecting the supply and demand of grains and oilseeds. The greater fungibility of PROCAMPO's payments is easing cash constraints faced by producers. Within Alianza para el Campo, the mechanization and improved seed ("kilo por kilo") programs are likely to have positive effects on grain and oilseed production. But the program to increase domestic production of palm and coconut oils will most likely abate domestic prices of vegetable oils, and will therefore reduce producers' incentives to cultivate annual oilseed crops. The feed industry's dependence on imports of high-protein oilseed meals is therefore likely to continue. Meanwhile, the greater flexibility in grain and oilseed marketing supports now operated by CONASUPO and ASERCA, is having positive repercussions on producers' pockets.

Surveys of the major production systems for grains and oilseeds conducted by FIRA in recent years convey an optimistic panorama for domestic producers of grains and oilseeds, with the exception of soybeans. Although farmgate prices and production costs vary widely, depending on the region and the water regime, in most cases the profitability of these crops increased between 1994-94 and 1996-96, as real prices rose and per-ton production costs fell. The evolution of the profitability of these crops is, however, likely to remain highly differentiated geographically and technology-wise, even among commercial producers.

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