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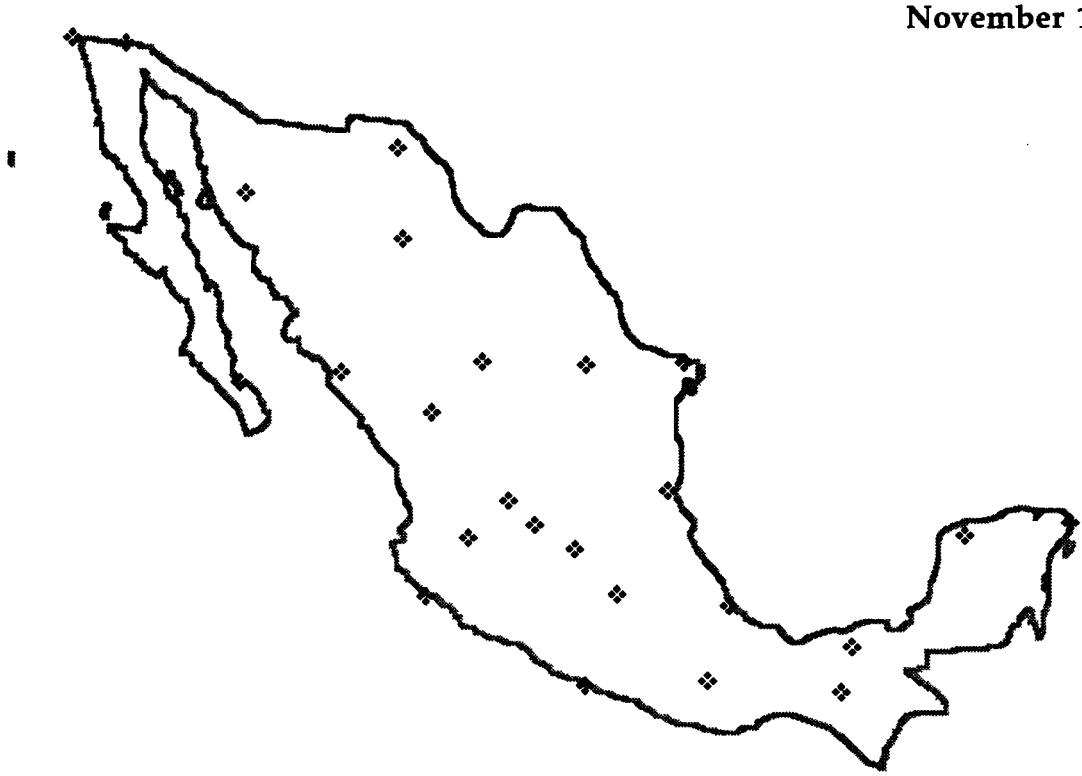

MEXICO'S DAIRY SECTOR IN THE 1990S: A DESCRIPTIVE ANALYSIS

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Abstract

Mexico's dairy sector is diverse. Regional differences in production systems and seasonality, processing technology and infrastructure, and consumer preferences and purchasing power imply a strong need for spatial disaggregation in analysis of the country's dairy industry. This bulletin summarizes the characteristics of milk production, dairy processing, consumer demand, and trade in dairy products in Mexico as of 1994. Expenditure elasticities for eight dairy products estimated from household expenditure surveys indicate the potential for future growth in dairy product demand. A dairy components balance for Mexico in 1992 indicates significant discrepancies in aggregate dairy production, consumption, and trade data. Future studies of the Mexico's dairy industry could benefit from more reliable and comprehensive data on milk production and composition, dairy product consumption, costs in the marketing chain, and the responsivness of producer and consumer decisions to prices.

Preface

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the policy landscape into the middle of the 1980s. An array of governmental agencies and parastatal corporations participated in programs to administer feed grain subsidies and technical assistance to low-resource dairy farmers, while food grains (wheat and corn) were prohibited for use as livestock feed. The Compañía Nacional de Subsistencias Populares (CONASUPO), a parastatal operating through its subsidiary Leche Industrializada de la Compañía Nacional de Subsistencias Populares, S. A. (LICONSA), exercised near-complete control over nonfat dry milk (NDM) imports. LICONSA-owned and -operated rehydration plants processed the milk powder and vegetable oils into the "fluid" milk sold to the poor. Controls on producer and retail prices, designed to control inflation, forced processors to vertically integrate, to adulterate their products with non-milk components or excessive water, and to seek alternative markets (Muñoz, 1990). The quality of dairy products suffered, and increasing quantities of fluid milk were marketed as *leche bronca* (raw milk sold for direct consumption) to consumers seeking a "purer" dairy product than those proffered by dairy companies.

Trade policies focused on protecting Mexico's domestic markets from foreign competition. Tariffs on other imported dairy products provided Mexican dairy producers and processors with substantial protection, and few consumers outside of the states bordering the US had much experience of imported dairy products.

Nineteen eighty-six marked a turning point. Mexico's accession to the General Agreement on Tariffs and Trade (GATT) was a major step for a country as acutely desirous of food self-sufficiency as Mexico (Adelman and Taylor, 1990). Accession forced the reduction of average tariff rates on agricultural products; tariffs on imported dairy products were halved from 40% to a maximum of 20%. To some observers, it was as if the dam protecting Mexico's agriculture had been breached (Muñoz and Odermatt, 1992). Import licenses administered by CONASUPO retained their potency as regulators of dairy imports, but a new era of more market-oriented competition had begun.

Since 1986, Mexico's dairy industry has faced many challenges and changes, even before the most recent "peso crisis" of late 1994 and early 1995. At the level of national economic policy, direct foreign investment in agriculture and agribusiness, once discouraged, began to be actively sought. Land use restrictions once sacrosanct were abandoned to the free-market, productivity-growth imperative. The slow devaluation of the peso, now regarded as precipitating the current macroeconomic crisis, maintained the purchasing power of Mexican producers (importers of production inputs) and consumers (importers of imported finished products).

In the dairy sector, subsidies to producers, never particularly effective, were largely eliminated. A regional system of more flexible producer price controls encouraged increases of over 7% per year from 1989 to 1992. Consumer price controls were phased out for all dairy products except 1-liter packages of pasteurized milk. Lower prices for imported feed grains, heifers, bovine somatotropin (bST, approved in July of 1990), and equipment from the US and Canada contributed further to the transformation of specialized dairy production systems in Mexico. However, dual-purpose (milk- and beef-producing) farms in central and

southeastern parts of the country continued to provide a substantial share of the nation's raw milk supplies.

Despite rapid growth in domestic production of milk, demand for dairy products has grown more rapidly. Mexico remains one of the world's largest importers of dairy products. Growth in per capita income, and the government's promise in 1994 to expand the coverage of the social programs providing subsidized milk portend increased reliance of Mexico's dairy consumers on world markets. Increased access to imported dairy products, especially products for retail sale from the US, have begun to shape Mexican consumer's preferences, expectations, and purchasing patterns (Muñoz, 1990; National Dairy Promotion and Research Board, 1992a; IMOP/Gallup Mexico, 1993a). Thus, the nine years since accession to GATT have seen reduced involvement by the Mexican government in the domestic dairy market, and a closer interrelationship between domestic and international dairy markets.

In the years prior to the implementation of the North American Free Trade Agreement (NAFTA), US universities and industry groups conducted a plethora of studies characterizing the Mexican dairy sector and predicting the potential of NAFTA to increase US exports of dairy products (Schulthies and Schwart, 1991; Harris and McClain, 1991; Hallberg *et al.* , 1992; Cranney, 1992; Outlaw and Nicholson, 1994) University and trade group counterparts in Mexico pursued parallel studies, albeit with often-different conclusions concerning the benefits of liberalized trade (Muñoz *et al.*, 1994). These studies provide a starting point for exploration of the diversity of dairying in Mexico, but they often ignored the dairy marketing subsector, and glossed over issues relating to the inconsistency of dairy-related statistics. Thus, in the sections that follow, I compare and contrast information about production, processing, and consumption from different sources as necessary and possible.

Production Systems

In 1992, Mexico produced somewhere between 7,000 million liters and 10,800 million liters of cow's milk[1]. This quantity is roughly equal to the amount produced in California or Wisconsin in 1992, and places Mexico ninth among the world's dairy producers. Growth in total cow's milk production in Mexico since the mid-1980s has been described as "uneven" (Knutson *et al.*, 1993). Production declined 3.0% per year between 1985 and 1990 (Figure 1), largely due to government price controls and related policies (Outlaw and Nicholson, 1994). From 1990 to 1993, production rebounded due to changes in pricing policies, and the sector experienced growth of 6.6% per year. The effects of the "exchange rate crisis" of late 1994 and early 1995 on milk production are not yet known.

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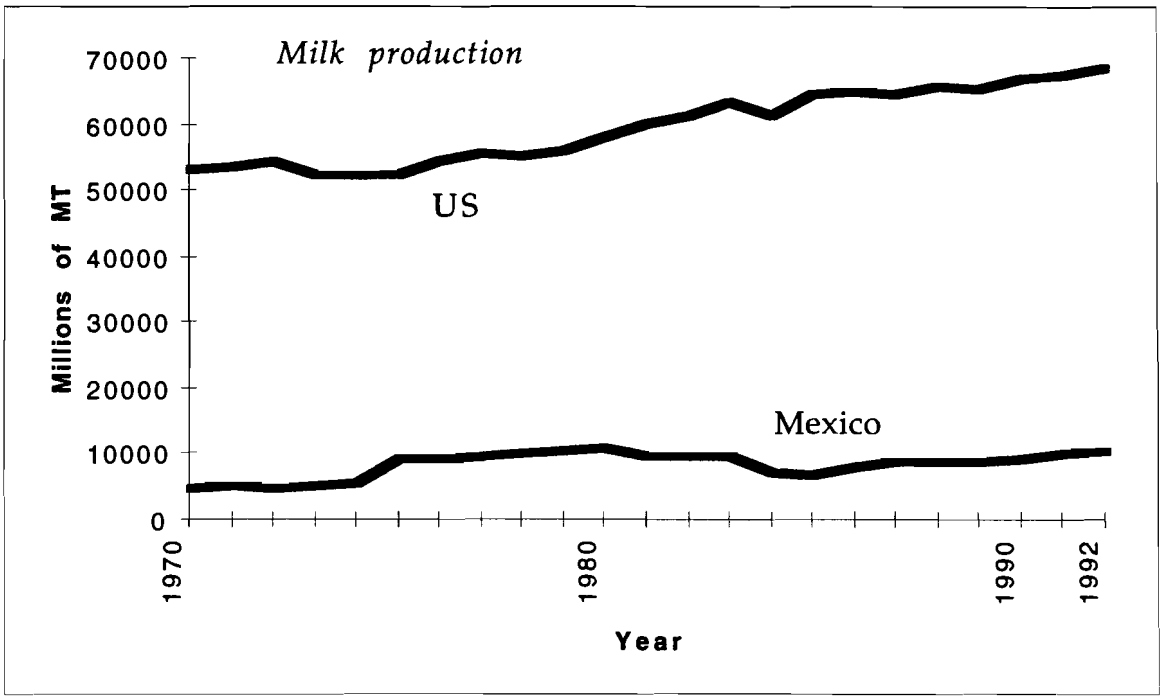
[1] The Secretaría de Agricultura y Recursos Hidáulicos (SARH) of the Mexican government estimated 1992 milk production as 6,974 million liters. The Dairy Annual Report from the USDA's Foreign Agricultural Service office in Mexico estimates 1992 milk production as 10,800 liters.



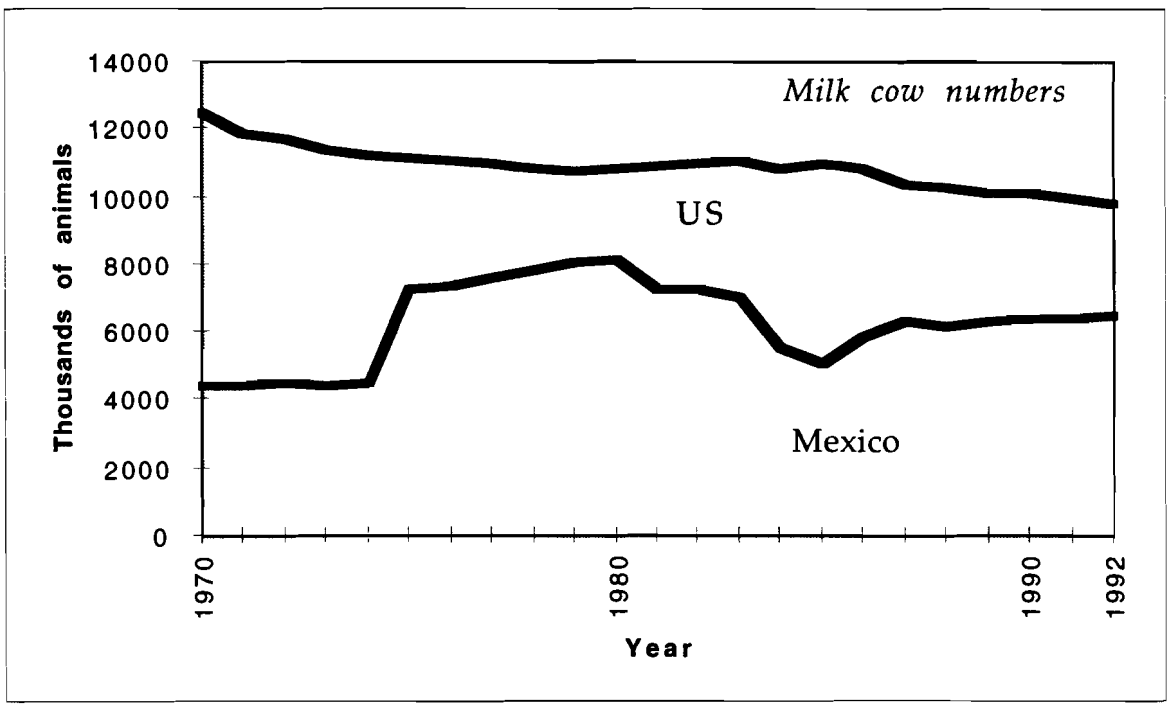


Figure 1. Milk Production and Milk Cow Numbers, Mexico and the US, 1970-92

Goat's milk is sometimes used in combination with cow's milk for manufactured dairy products in north central Mexico during the summer flush season. However, the estimated annual production of goat's milk was only 148 million liters in 1992 (Confederación Nacional Ganadera, 1994).

Mexico's dairy farms frequently are classified as *specialized* (confined), *semi-specialized* (family or semi-confined), or *dual-purpose* (tropical milk and beef). Each of these systems uses distinctly different inputs to produce distinctly different quantities of milk per cow and per unit land (Table 1). Milk production is distributed throughout the country, with concentrations in the north central states (the *Comarca Lagunera*), and south central Mexico (Figure 2).

Specialized operations are located primarily in the border states, the Comarca Lagunera, and the altiplano[2] (Table 1) These herds are estimated to contain about one quarter of the national dairy herd. These specialized farms provide 25 to 55% of the nation's milk production, and about 80% of the pasteurized milk consumed in urban areas (Schulthies and Schwart, 1991; Muñoz *et al.* , 1994). Holstein cows in herds up to thousands of cows receive diets of alfalfa hay, corn silage and commercial concentrates. Replacement heifers often are imported from the US and Canada, although a small number of operations in Mexico produce quality breeding stock. Specialized production is most often located in irrigation districts because the alfalfa hay and corn silage are often produced on-farm (or nearby) with irrigation water from deep wells (Muñoz, 1990). The majority of cows in specialized operations produce 4,000 to 6,000 liters of milk per year, but one cooperative reports that a number of its producers routinely exceed 9,000 liters per cow per year (Victor Gavito, Alpura, personal communication).

Artificial insemination is typical, most farms sport milking machines and on-farm cooling tanks, and the use of bST (approved in July 1990) is common but not predominant. Milk production is seasonal, with lower (10-15%) production during the hottest months of July and August. The specialized system relies on imported production inputs such as replacement heifers, equipment and machinery, semen, seed, medicines. Mexican producers purchased over 20,000 replacement heifers and $3 million worth of semen from the US in 1992. Roughly 70% of total production costs on specialized farms are for feed[3] (Muñoz *et al.* , 1994).

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[2] The Comarca Lagunera is the northern basin centered on the cities of Torreón and Gómez Palacio on the border of Coahuila and Durango states. The altiplano comprises the highland areas of the south central states surrounding Mexico city, stretching roughly from Aguascalientes in the north to Puebla in the south.

[3] For comparison, feed costs for all US dairy farms accounted for about 40% of total production costs in 1992 (New York Agricultural Statistics Service, 1995).

Table 1. Characteristics of Dairy Production Systems in Mexico, early 1990s

Characteristic	Production System: Specialized			Semi-Specialized			Dual-purpose
Herd size, cows[1]	221	602	1089	8	14	29	27
Milk per cow (kg/day)	20.1	21.4	22.8	10.4	10.1	10.0	3.9
Concentrate per cow (kg/day)	8.9	9.7	10.2	5.2	5.4	5.9	0
Production cost, (N$/liter)	0.92	0.80	0.86	1.43	1.06	1.21	0.79
DRC[2]	7.6	4.8	4.2	10.4	6.5	4.8	2.4
Principal regions	Border states, Comarca Lagunera, altiplano			Altiplano, west central states			Gulf coast, Southeastern states
Principal feeds	Alfalfa, corn silage, concentrates			Grazing native and improved pastures, alfalfa, concentrates			Grazing native and improved pastures, crop by-products
Genetics	Purebreds, largely Holsteins, AI widely used			Holstein and Brown Swiss of lower genetic potential			F1 crossbreds, Holstein or Brown Swiss with Zebu, Criollo
Milking and cooling equipment	Milking machines, cooling tanks on farm			Hand milking, few cooling tanks on farms[3]			Hand milking, regional milk collection centers
Percentage of national milk supply[4]	25 to 55%			17 to 45%			28 to 40%

[1] Representative herd sizes from Odermatt (1993). SARH (1992) reports mean herd sizes for the three systems as 230, five to 40, and 80 cows, respectively. Odermatt's figures are used because they are based on more recent farm surveys.

[2] The Domestic Resource Cost (DRC) measures the value of domestic resources per unit of output value. For example, 4.2 to 7.6 N$ worth of resources are required to produce milk valued at 1 N$ in the specialized production system.

[3] Nestlé is establishing a network of on-farm cooling tanks, and hopes to have 100% of its producers in such a network within the next few years. However, as of mid-1994, most producers in the semi-specialized and dual-purpose systems did not chill milk on-farm.

[4] Estimates of production from each system vary widely. Schulthies and Schwart (1991) estimate the percentages provided by the three systems as 55, 17, and 28%, respectively. In contrast, Muñoz (1990) cites FIRA data indicating 25, 35, and 40% from the systems, respectively. The differences may be due in part to different estimates of total milk production.

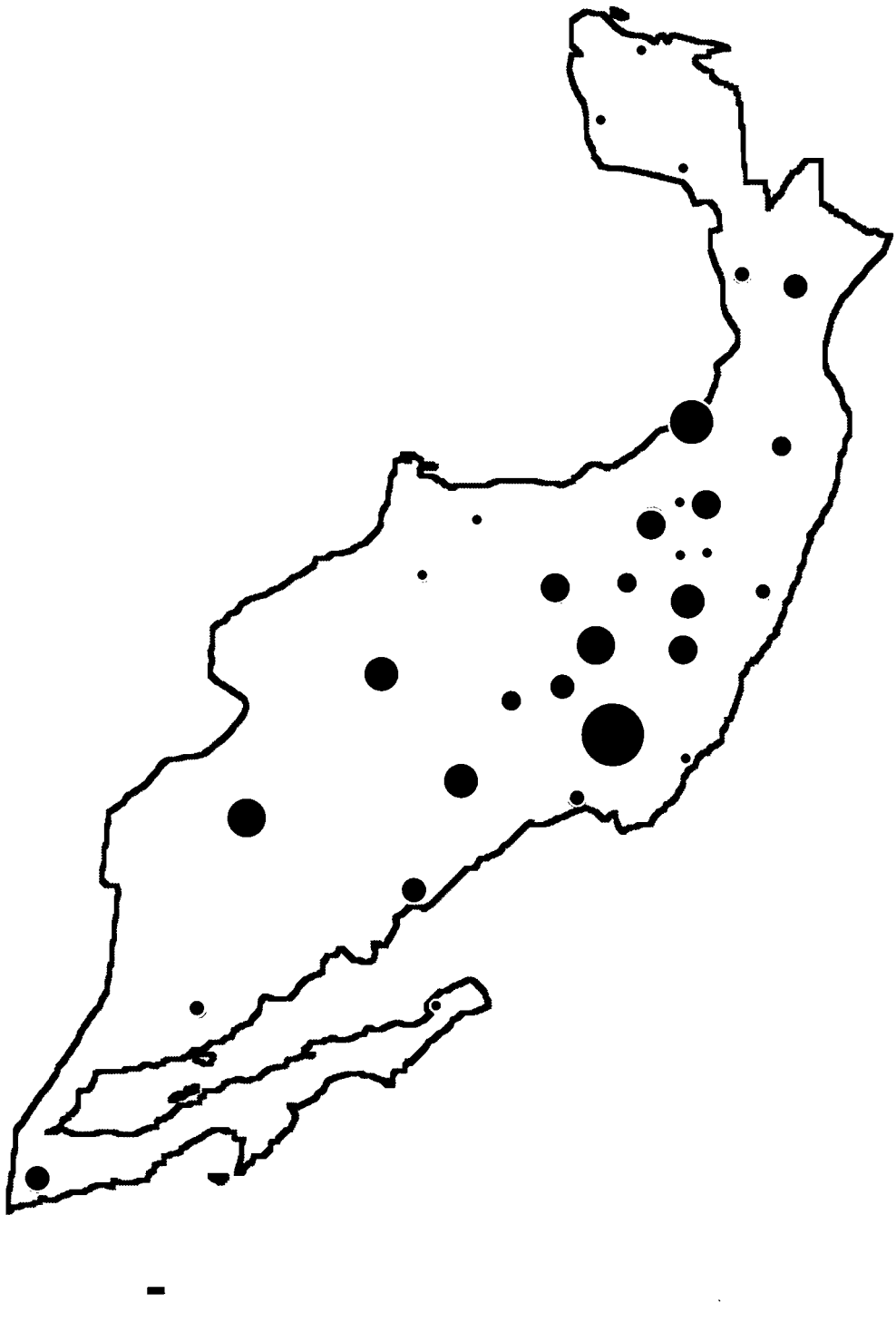

Figure 2. Proportional Distribution of Milk Production by States in Mexico, 1992

Most specialized producers are organized into large dairy cooperatives that provide a range of production and marketing support services, such as credit unions, input supplies at wholesale prices, integrated production of concentrate feeds, and processing and distribution of dairy products. This vertical integration helped specialized producers to survive in the face of significant disincentives in the late 1980s (Muñoz, 1990). Most of the milk produced in specialized systems is marketed through the cooperatives. Thus, the milk is shipped by insulated tankertruck from the farm to larger, more modern processing plants producing a variety of dairy products.

Semi-specialized farms are found primarily in the altiplano and the west central states. Comprising about one-quarter of all Mexican dairy farms, they provide 17 to 45% of Mexico's milk supply. Holstein and Brown Swiss cows of genetic potential lower than that of cows in specialized operations produce about 2,400 to 4,000 liters per cow per year. These cows feed on native or improved pasture, agricultural by-products (*e.g.*, corn stover), and, less commonly, alfalfa hay, grain, or oilseed meal. Milk production is more seasonal in the semi-specialized system than the specialized system because pasture growth is most vigorous during the summer rains (May to November). Herd sizes are small; Odermatt (1993) used 29 cows as the mean for his largest herd grouping in a survey of semi-specialized producers.

Investment in equipment is minimal for most semi-specialized farms. Family labor is key to the success of the operation (Muñoz, 1990), and most milking is by hand. Milk quality tends to be low, because of farm practices and because on-farm chilling of milk is rare. However, some dairy processing companies are attempting to improve the quality of milk purchased from semi-specialized producers. As of 1994, Nestlé was instituting a system of local (often on-farm) cooling tanks among producers supplying it with milk, and Sello Rojo (based in Guadalajara) recently initiated a technical assistance program for its suppliers. Such support remains uncommon, and most semi-specialized producers have little access to technical assistance services. Muñoz *et al.* (1994) claim that semi-specialized producers often earn low incomes and negative real returns to land and labor. The semi-specialized system survives, they assert, on under-compensated family labor which has few more attractive economic opportunities.

Nearly all of the milk produced by semi-specialized farms is marketed through one or more of three channels: Nestlé Company, artisanal cheese makers, or as *leche bronca*[4]. An estimated 50 to 60% of Mexico's *leche bronca* originates on semi-specialized farms. Muñoz (1990) and others assert that Mexico's social program that provides subsidized milk for low-income consumers reduces the market for milk from semi-specialized producers. Most marketing arrangements are unstructured, but the Sello Rojo company is attempting to establish supply contracts

[4] In what follows, I use *leche bronca* to describe unpasteurized milk sold directly to consumers (by the farmer or an intermediary) for home consumption. Note that other authors have used *leche bronca* to mean all milk marketed through the "informal" sector, such as artisanal cheese makers.

with producers in the Guadalajara region in conjunction with its efforts to provide technical assistance (Carlos Sosa, INIFAP, Ajuchitlán, personal communication).

The *dual-purpose* system developed as an outgrowth of beef production in Mexico's tropics to take advantage of the region's abundant forage resources. Milk production also increases the frequency of cash receipts by the farm household, while maintaining a presence in the beef markets. Muñoz (1990) distinguishes three subcategories of dual-purpose systems: the *traditional* (beef-oriented), *improved*, and *intensive tropical dairying*, which increasingly emphasize milk production over beef production.

Dual-purpose herds contain about 60% of all "dairy" (*i.e.*, milk- producing) cows, and provide 28 to 40% of Mexico's raw milk supplies. The greatest concentration of dual-purpose herds is found in the tropical lowlands of Mexico's Gulf coast, with significant numbers of such farms stretching northward into the states of Tamaulipas, San Luis Potosí, and Veracruz. Zebu cows, Holstein-Zebu and Brown Swiss-Zebu crosses in herds averaging about 30 cows produce 300 to 700 liters of saleable milk[5] per cow per year. Grazed native or improved pastures are the principal feeds; supplementation is minimal in most herds, but sometimes by-products such as coconut meal, wheat bran, molasses and rice straw are fed to milking cows and growing calves. Most dual-purpose farms retain calves until weaning, and then either raise them to marketable weights or sell them to others who will do so. Thus, in contrast to the specialized and semi-specialized systems, dual-purpose producers receive a greater percentage of their income from beef[6].

Individual dual-purpose farms often receive little or no technical assistance, but the Mexican government has established a significant number of projects to conduct research and promote the transfer of improved technologies (such as intensive grazing) to dual-purpose producers. These projects include assessment of the most productive level of European germplasm in crossbred cows (SARH/INIFAP, 1994), estimated costs and returns for various technologies (FIRA, 1994), and producer groups designed to facilitate technology.

The equipment and machinery found on most dual-purpose farms is minimal compared to specialized farms. Land typically constitutes the major investment. Purchased feed costs are minimal, whereas labor and land rental account for over 70% of total costs of milk production (Odermatt, 1993). Hand milking is the rule, although exceptions can be found. Production of milk is highly seasonal because forage production is seasonal. During the rainy summer (typically May to November), pasture growth supports increased total milk production. With the arrival of the *Nortes* (cold fronts) late in the year, milk production drops off dramatically. Estimates of the difference in monthly peak and trough production in

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[5] Because some milk is provided to the calf, total milk production is greater than the amount of milk available for sale.

[6] Muñoz (1990) reports that *traditional* dual-purpose producers may receive up to 50% of cash receipts from sales of cattle for beef.

the dual-purpose system range from 50 to 400% of the quantity produced during the trough.

Milk from dual-purpose farms is marketed to local cheese makers, as *leche bronca*, and to companies such as Nestlé or Ultralácteos. In studies of milk marketing in Mexico's tropics conducted in the late 1980s, Muñoz *et al.* (1991) found that 51%, 28%, and 19% of milk went to these outlets, respectively. They also noted how seasonality of production and consumption affects producers' milk marketing choices. During the summer flush season, more milk is sold *bronca* or to the companies, because cheese makers cannot absorb all of the production. The arrival of the Christmas and Easter holidays increases demand for cheese, and cheese makers snatch up the more limited raw milk production at higher prices. The dramatic changes in production and marketing patterns have resulted in great price variations throughout the year (Muñoz *et al.*, 1991), leading some dairy industry representatives to suggest that marketing contracts are necessary to promote market stability (Miguel García W., LICONSA, personal communication).

Health concerns are common in all three production systems. SARH (1992) estimated the incidence of tuberculosis and brucellosis in confined cattle herds as 2 and 8%, respectively, estimating the resulting economic loss at over 80 billion (old) pesos. External parasites in specialized and semi-specialized herds caused an estimated 11% increased in production costs, according to the same SARH study. Mastitis present in 80% of cows (with 12% clinical presentation) resulted in estimated milk production losses of 5 to 20%.

Producer prices for raw milk vary with region, season, and marketing channel. Average estimated producer prices in Mexico for 1992 (Table 2) were highest in the Comarca Lagunera (1,016 (old) pesos per liter, or $14.62 per hundredweight at 1992 exchange rates) and lowest in Nayarit, Chihuahua, and Chiapas (about 700 (old) pesos liter, or $10.08 per hundredweight at 1992 exchange rates). These price differences reflect milk quality (chilled milk from specialized farms often receives a premium), the degree of vertical integration of processors and producers, and the availability of marketing outlets. Although the dairy cooperatives often pay premiums for fat contents greater than 3.5%, apparently only small amounts of milk qualify for them (Antonio Hernández, Lala, personal communication).

Milk composition also varies with season and production system. Fat contents ranged from 2.7 to 4.8% during the year in tropical herds (Muñoz *et al.*, 1991), with lowest fat content during the summer flush season. Dual-purpose herds are reputed to produce milk with a higher fat content, but the available empirical evidence does not demonstrate this unequivocally (Muñoz *et al.*, 1991; SARH, 1994). The average annual estimated fat content of Mexican milk is 3.3% (a variety of sources cited this figure during interviews in June 1994).

Table 2. Milk Production in Mexico, 1987 and 1992, by Region and State

Region, state	Milk production (SARH) 1987 (000 liters)	1992 (000 liters)	% of total, 1992	Growth rate, 1987-92 (%/yr)	Producer price (1992 Pesos)
Northwest	347,350	283,590	4.07	-3.97	866
Baja California	230,500	172,525	2.47	-5.63	900
Baja California Sur	21,820	18,793	0.27	-2.94	813
Sonora	95,030	92,272	1.32	-0.59	813
North Central	1,284,116	1,500,008	21.51	3.16	868
Chihuahua	359,233	510,370	7.32	7.28	700
Coahuila	314,068	407,153	5.84	5.33	900
Durango	378,296	376,140	5.39	-0.11	1,016
Nuevo Leon	23,605	25,000	0.36	1.15	929
Sinaloa	208,914	181,345	2.60	-2.79	950
Southwest	1,348,269	1,629,624	23.37	3.86	798
Colima	36,773	34,596	0.50	-1.21	784
Guerrero	54,044	59,555	0.85	1.96	900
Jalisco	1,021,628	1,220,779	17.50	3.63	813
Michoacan	214,024	259,737	3.72	3.95	726
Nayarit	21,800	54,957	0.79	20.31	697
Altiplano	1,912,415	2,055,314	29.47	1.45	819
Aguascalientes	188,726	217,599	3.12	2.89	871
DF	42,070	16,337	0.23	-17.24	958
Guanajuato	452,315	543,630	7.80	3.75	871
Hidalgo	199,790	313,732	4.50	9.45	775
Mexico	448,308	409,250	5.87	-1.81	755
Morelos	53,612	19,105	0.27	-18.65	725
Puebla	237,336	266,470	3.82	2.34	750
Queretaro	125,099	152,910	2.19	4.10	871
Tlaxcala	81,560	75,390	1.08	-1.56	813
Zacatecas	165,159	116,281	1.67	-6.78	900
Tropics	1,227,270	1,430,073	20.51	3.11	745
Campeche	21,263	11,112	0.16	-12.17	800
Chiapas	232,828	217,380	3.12	-1.36	709
Oaxaca	136,919	144,178	2.07	1.04	755
Quintana Roo	5,015	2,470	0.04	-13.21	871
San Luis Potosi	213,268	278,705	4.00	5.50	740
Tabasco	89,810	87,320	1.25	-0.56	842
Tamaulipas	26,824	23,832	0.34	-2.34	742
Veracruz	485,303	644,160	9.24	5.83	740
Yucatan	16,040	20,916	0.30	5.45	813
Total	6,200,980	6,973,999	100.00	2.38	810

The protein content of milk also varies through the year, ranging from 2.9 to 3.5% based on studies conducted in the altiplano. The average annual estimated total protein content of raw milk is 3.0%. Most analysts and dairy industry representative assume that bacterial loads in milk produced in the semi-specialized and dual-purpose systems are high. However, Muñoz *et al.* (1991) reported that milk from crossbred cows may be more resistant to microbial growth than milk from purebred cows under equivalent treatment.

Policies Affecting Dairy Production

In the late 1980s, Mexican dairy producers labored under the burden of government policies favoring urban consumers of dairy products. Producer and consumer price controls, administered at the national level, reduced producer incentives to expand dairy herds and milk production; in fact, milk production declined by 3% per year from 1985 to 1990 under what producer organizations described as a "vicious cost-price squeeze" (Muñoz, 1990). Land use restrictions enshrined in the Mexican Constitution limited farm size, and made large landholdings subject to seizure and redistribution. Feed grains such as corn and wheat not produced on-farm were prohibited for use as animal feed, so the quality of dairy rations was poor according to Schulthies and Schwart (1991). Small and selective feed and genetics subsidies provided by quasi-governmental corporations such as ALBAMEX, ICONSA, and LICONSA had limited impact on milk production.

Tariffs on dairy product imports were reduced to 20% or less with Mexico's accession to GATT in 1986, but massive imports of nonfat dry milk (NDM) for social programs, albeit controlled by government import permits, undermined incentives for dairy producers. An overvalued exchange rate during much of the 1980s provided an implicit subsidy to producers who purchased imported inputs (Hallberg *et al.*, 1992). Estimated producer subsidy equivalents (PSE)[7] were negative for most years during the 1980s. Hallberg *et al.* (1992) estimated a PSE of -6.23% of the producer milk price for 1989; Muñoz *et al.* (1994) estimated a negative PSE of 58% for 1982-88, stating that price was the principal factor.

Since the late 1980s, policies designed to liberalize dairy markets and promote greater competitiveness have been paramount. Starting in 1988, producers, processors, retailers, and government representatives negotiate regional producer prices, known as *precios concertados*. The consumer price serves as "base" price, and other prices in the system are determined based on traditional or "reasonable" margins, with some consideration of production costs (Hallberg *et al.* 1992). In addition to regional producer price negotiations, the government later completely liberalized consumer prices for previously controlled products such as yogurt and

[7] PSEs measure the amount of income a producer would need to be compensated if all government programs in effect at the time of the calculation were removed. A positive PSE indicates that the government subsidizes producers.

some cheeses. Producer prices may now vary seasonally or in response to local market conditions[8].

Restrictions on land use and foreign investment in agriculture have also been eased, a remarkable reversal of policies in place just a decade ago. Redistribution of large landholdings was prohibited in 1992, and vast numbers of hectares held communally by *ejiditarios* became potentially available for incorporation into expanded dairy or forage crop operations. One hundred percent foreign ownership of agricultural investments was permitted in 1991, although to date there is little evidence of increased foreign investment in dairy production.

NAFTA, which came into force in January 1994, also represented a significant break with previous policies. Although it provides US dairy producers and companies with greater access to Mexican markets, it will also allow Mexican dairy producers (especially in the specialized system) to purchase imported inputs more cheaply. Thus, NAFTA will provide both incentives and disincentives to dairy production in Mexico.

The changes in dairy price policies resulted in a rebound in milk production; the milk supply increased close to 10% in both 1990 and 1991, although increases since then have been more moderate (3.8% in 1992, for example). The changes in land use regulations are expected to provide incentives for increased milk production in coming years.

Potential for Future Growth in Milk Production

Future milk production in Mexico will be influenced by five principal economic forces. These forces include the price and accessibility of imported inputs for the specialized system, the price and availability of water and feed resources in north-central Mexico, expenditures for research and infrastructure development, especially in the tropics, the producer prices resulting from demand growth and the *precios concertados* pricing policy, and the peso-denominated prices of imported dairy products.

SARH presented a comprehensive "Program to Increase Milk Production" in May 1992. The program's premises and proposals illustrate the disparate actions the Secretaría viewed as necessary for Mexico to achieve self-sufficiency in milk production. In addition to increasing the milk price paid to producers and limiting imports of intermediate dairy products such as NDM, the program suggested actions for organizing producers into cooperative institutions, improving milk per cow in semi-specialized herds, modifying feeding practices (especially in dual-purpose herds), providing more resources for animal health and sanitary regulation of milk products, devoting greater expenditures to research and development of infrastructure, and increasing producers' accessibility to credit. The envisioned

[8] Some observers claim that pricing has changed little in the less specialized systems under the "liberalization" of producer prices in 1988, because their marketing channels were less regulated than those for specialized producers (Muñoz, 1990).

expenditures for this program totaled over $1.6 billion for 1992-97, although it was never put into place. The breadth of the program's activities and its lofty price tag indicate the magnitude of the challenges that Mexican dairy producers will face for the remainder of this decade and beyond.

Befitting the diversity of dairy production systems in Mexico, little consensus exists among dairy industry representatives on the relative importance of input accessibility, water availability, and government expenditures for infrastructure. Neither is there agreement on how the different production systems will respond to the changing economic and policy environment, although nearly everyone concurs that a higher milk price will stimulate production increases (Muñoz *et al.* , 1994).

Milk production in the specialized system is generally regarded as "stable" (José Luis Cruz, US Embassy, personal communication), despite other claims that it has been "in crisis"for a number of years (Muñoz, 1990). As of mid-1994, producers were attempting to increase milk production per cow, rather than expanding herd size (Victor Gavito, Alpura, personal communication), especially because they currently lack the capital to undertake the "enormous" required investments and did not want to increase borrowings.

The most important issues for the specialized system will be the cost and availability of water (feed) resources, and the impact of NAFTA on input prices. Water plays a key role because it provides the basis for the alfalfa-based feeding systems prevalent in north central Mexico, and feed costs account for 70% of total production costs in the specialized system. SARH (1992) noted that specialized dairy production takes place in areas where aquifers are considered overexploited, and that falling groundwater levels have increased pumping costs. The Program to Increase Milk Production stated that increased pumping costs "have important implications for production potential" in specialized systems. Accordingly, the program recommended that forages other than alfalfa be sown to conserve water. In Aguascalientes state, where milk production increased 14.2% from 1989 to 1993, groundwater replenishment was estimated at only 43% of extractions; forages accounted for nearly half of agricultural water use in the state in 1993 (SARH, 1993).

Despite falling groundwater levels, new barns continue to be built in north central Mexico, and many producers do not consider groundwater availability a problem (Carlos Martínez, veterinarian in Gómez Palacio, personal communication). The largest dairy cooperative in the Comarca Lagunera foresees growth in milk production of 5-10% per year for the next few years, although "water may be a constraint" (Antonio Hernández, Lala, personal communication).

Access to cheaper feed grains and oilseeds will be beneficial to producers in the specialized system in the near future (Gonzalo Cevallos, Holstein de Mexico, personal communication). However, specialized producers closer to the border, who are less vertically integrated, may not benefit as much as those producers in the large cooperatives farther south. Thus, vertical integration will be tied to future growth in milk production (Gonzalo Cevallos, Holstein de Mexico, personal communication). Access to US genetics is expected to change little with NAFTA, because no tariffs or quotas were applied to such imports prior to 1994. NAFTA is

expected to improve the accessibility of new and used farm equipment, spare parts, and technical consulting, which would tend to benefit producers in the specialized system (Knutson *et al.* , 1993). However, the exchange rate crisis of late 1994 and early 1995 may raise peso prices of imported inputs for some time to come, offsetting the relatively small changes in prices due under NAFTA.

The semi-specialized production system figures little in discussions about the future of milk production in Mexico. The Program to Increase Milk Production (SARH, 1992) mentions the need to improve the genetic quality of cows on semi-specialized farms, but few analysts seem willing to embrace major support for such improvements because production costs are 44 to 56% higher in the semi-specialized system (Table 1) than in the other two systems. The semi-specialized system also had the highest domestic resource cost (DRC), with a value of resources to value of product ratio as high as 10.4 for the smallest farms (Odermatt, 1993). As a result, many analysts foresee little growth, or perhaps even a decline, in milk produced on semi-specialized farms.

Advocates of dual-purpose production systems assert that the future of milk production in Mexico will be found in the tropics. In 1991, a study conducted by the consulting firm Agrobiotec with assistance from the University of Wisconsin stated: "the best opportunity is in the tropics, using crossbred cattle...in the long term, expansion of intensive production isn't probable, even with a more aggressive governmental support policy" (p.2)[9] Muñoz (1990) claimed that the tropics offered broad potential for achieving "sovereignty" in dairy production, with the most viable alternative being the development of the traditional system towards more intensive production of milk. Later studies by Odermatt (1993) suggested that although none of Mexico's milk production systems have a comparative advantage (Table 1), the domestic resource cost of production in the tropics was much lower than that for specialized production in the Comarca Lagunera. Muñoz *et al.* (1994) also cited recent studies in Mexico's tropics suggesting that milk production per cow and per unit land can be increased some one half to ten times current levels with intensive grazing technologies (FIRA, 1994). In addition, supporters of the dual-purpose system cite its lower reliance on imported inputs and positive equity effects in rural areas as justification for a dairy development strategy focusing on the tropics (Seré and Rivas Ríos, 1989).

Other analysts cite the difficulties in expanding milk production in the tropics: extreme seasonality, poor marketing infrastructure, low milk quality, and slow adoption of improved production technologies by producers. The large fluctuations in milk production imply that tropical production systems will have difficulty providing milk for fluid markets in urban areas. Most of the milk currently produced in Mexico's tropics is processed into cheese or condensed fluid milk products with long shelf lives (Muñoz *et al.*, 1991). Poor transportation and marketing infrastructure in the tropics imply that although raw milk production costs are lower, the *delivered* cost of dairy products to consumers may be greater than from specialized production areas. Although improved infrastructure could

[9] Author translation of document originally written in Spanish.

promote increased production (Muñoz (1990), disputes this assumption) and improved milk quality, the required investments in the tropics would be large (SARH, 1992), and nearly impossible under the current "austerity" budget. The existence of much improved production technologies for the tropics mean little if producers have neither the resources nor the initiative to adopt such practices, argue proponents of specialized systems. "It's nothing more than foolishness" to consider milk production in the tropics seriously, commented the head of one Mexican dairy coop; "if it were feasible, it would have already been done".

Despite the difficulties, milk production in the tropics appears to have expanded greatly in the past 10 years (Roberto Saldaña, INIFAP, Mexico City, personal communication). One dual-purpose producer in Tabasco believes that conditions are right for a doubling of dual-purpose milk production in the next six years, although other analysts foresee no major changes in tropical milk production during those years (Heriberto Román P., INIFAP, Veracruz, personal communication).

Estimates of aggregate growth in milk production in Mexico during the next 10 to 15 years vary considerably. ITESM (1994) estimated annual production growth of 1.27% until the year 2000. Harris and McClain (1991) estimated growth between 5 and 8% annually based on recent historical performance of Mexico's dairy sector. Agrobiotec (1991) estimated annual production growth from 1990 to 2005 of 3.7%, based on predictions for four regions of the country. Growth was expected to be highest (5.2% annually) in northern Mexico (where specialized systems predominate), and next highest (3.5% annually) in central Mexico (the altiplano). Western and southwestern Mexico, where semi-specialized and dual-purpose farms are concentrated, had estimated annual growth rates of 3.0% and 2.1%, respectively.

Prediction of growth in milk production in Mexico is hampered by disparate estimates of the price elasticity of milk supply. Growth in per capita incomes and product price effects under NAFTA tariff reductions will affect producer prices for milk in coming years, and thus, will affect producer decisions regarding production. Estimates of long-run price elasticities of raw milk supply in Mexico range from 0.07 (Fonseca, 1991) to 1.08 (Cranney, 1992). The broad range of elasticity estimates, as well as the questionable data and methodologies employed to obtain them, mean that supply elasticities do not provide particularly helpful information about future growth in Mexican milk production.

Processing and Marketing Systems

Milk processing and marketing systems in Mexico are less well-studied than production systems. In general, there is little published information on transportation and marketing costs, or other measures of marketing system performance. Marketing channels for dairy products in Mexico are often categorized as "formal" or "informal". The "formal" marketing system comprises principally the large dairy cooperatives, their raw milk collection arrangements, and the wholesalers who distribute their products. Government-run companies such as CONASUPO and LICONSA also play an important role in "formal" marketing of

dairy products in Mexico. The "informal" marketing channels encompass a vast number of small, artisanal producers of cheese, *boteros* who purchase raw milk directly from farmers and sell directly to consumers, other small dairy processors, and small wholesalers who provide products to local markets. Both the "formal" and "informal" marketing sectors move significant amounts of dairy products from the farm gate to the final consumer.

Cooperatives with thousands of *socios* (members) are one of the key institutional players in Mexico's dairy marketing subsector. The largest of the cooperatives are Alpura, Boreal, Gilsa, Lala, and Ultralácteos. None of these cooperatives sells dairy products throughout the nation; milk collection and dairy product distribution is regional, although more than one cooperative has a presence in some regions. Together, the five cooperatives process most of Mexico's pasteurized fluid milk, UHT milk, and yogurt (Muñoz *et al.*, 1994). Each of these cooperatives has its origins in producer desire for vertical integration, and they all provide "member services" to producers in addition to processing raw milk into dairy products.

Nestlé is the largest single dairy company in Mexico. A subsidiary of the Swiss company of the same name, Nestlé dominates the manufacture of concentrated milk products such as milk powder, evaporated milk, and condensed milk (Muñoz *et al.* , 1991). Nestlé has long been active in the development of milk production in Mexico's tropics, which Muñoz *et al.* (1991) attributed to a desire to avoid competition with fluid milk processors serving urban areas. Nestlé recently initiated a program to promote local (often on-farm) milk cooling to replace a system based on regional milk collection centers.

Two quasi-governmental entities, CONASUPO (a subagency of the Secretaría de Comercio y Fomento Industrial, SECOFI) and LICONSA (itself a subagency of CONASUPO) are important players in Mexico's dairy marketing subsector. CONASUPO administers all imports of NDM and whole milk powder (WMP); LICONSA has the responsibility for a social program that subsidizes fluid milk purchases by low-income families. LICONSA, in particular, has recently reduced its involvement in the dairy sector by eliminating a program of producer subsidies and selling processing facilities it formerly owned. LICONSA continues to reconstitute large quantities of NDM and vegetable fat for sale in its own stores; about 70 to 85% of NDM imports are used for this purpose. NDM not used by LICONSA is auctioned to private industry by CONASUPO.

In addition to the large private and public companies, smaller private companies produce a wide variety of fluid milk products, frozen dairy desserts, and especially, cheeses. Mexico is reputed to have between 600 and 2,600 cheese plants (Table 3) that process about 16% of total raw milk production, and about 4,500 establishments that produce ice cream (SARH, 1992) Grupo Quan is the largest branded ice cream company, with about 62% of the branded market (NDPRB, 1993b).

Table 3. Estimated Number of Plants Producing Selected Dairy Products, 1992

Product, source	Number of establishments producing
Cheese, cream, or butter	2,800
Evaporated milk (can)	2
Evaporated milk (carton)	3
Infant forumlas	4
Milk replacer for calves	7
Other products	132
Pasteurized milk	42
Reconstituted milk	3
Nonfat dry milk	9
Whey powder	17
Whole milk powder	11
Yogurt	13

Source: SARH, 1992.

The milk marketing process often begins with the shipment of raw milk to a (formal or informal) processing facility (Figure 3). Milk collection in specialized production systems affiliated with cooperatives is similar to that in the US. Tankertrucks pick up milk from the farm at scheduled intervals, and deliver the milk to a processing facility. Cooperatives often ship farm milk long distances to dairy plants. Alpura, for example, ships milk from its *socios* in Chihuahua state to its principal processing facility outside Mexico City, a distance of some 1,500 kilometers. Some of the milk that Lala receives at its largest processing facility in Torreón, Coahuila, is shipped to other plants in Acapulco, Mexico City, Monterrey, and Durango.

Larger companies working with semi-specialized and dual-purpose producers, such as Nestlé and Ultralácteos, have developed regional collection and chilling centers known as *centros de acopio*. Farm milk is collected in milk cans or200-liter plastic barrels by independent entrepreneurs with pickup trucks (sometimes small boats if the farm is on a river), or is delivered to the *centro de acopio* by the farmer (Figure 3). At the *centro*, the milk is weighed, filtered, chilled, and stored until a tanker truck transports the milk to a central processing facility. Nestlé has recently instituted a program of local (on-farm) cooling tanks that provide greater flexibility for the farmer and the company (Muñoz *et al.* , 1994).

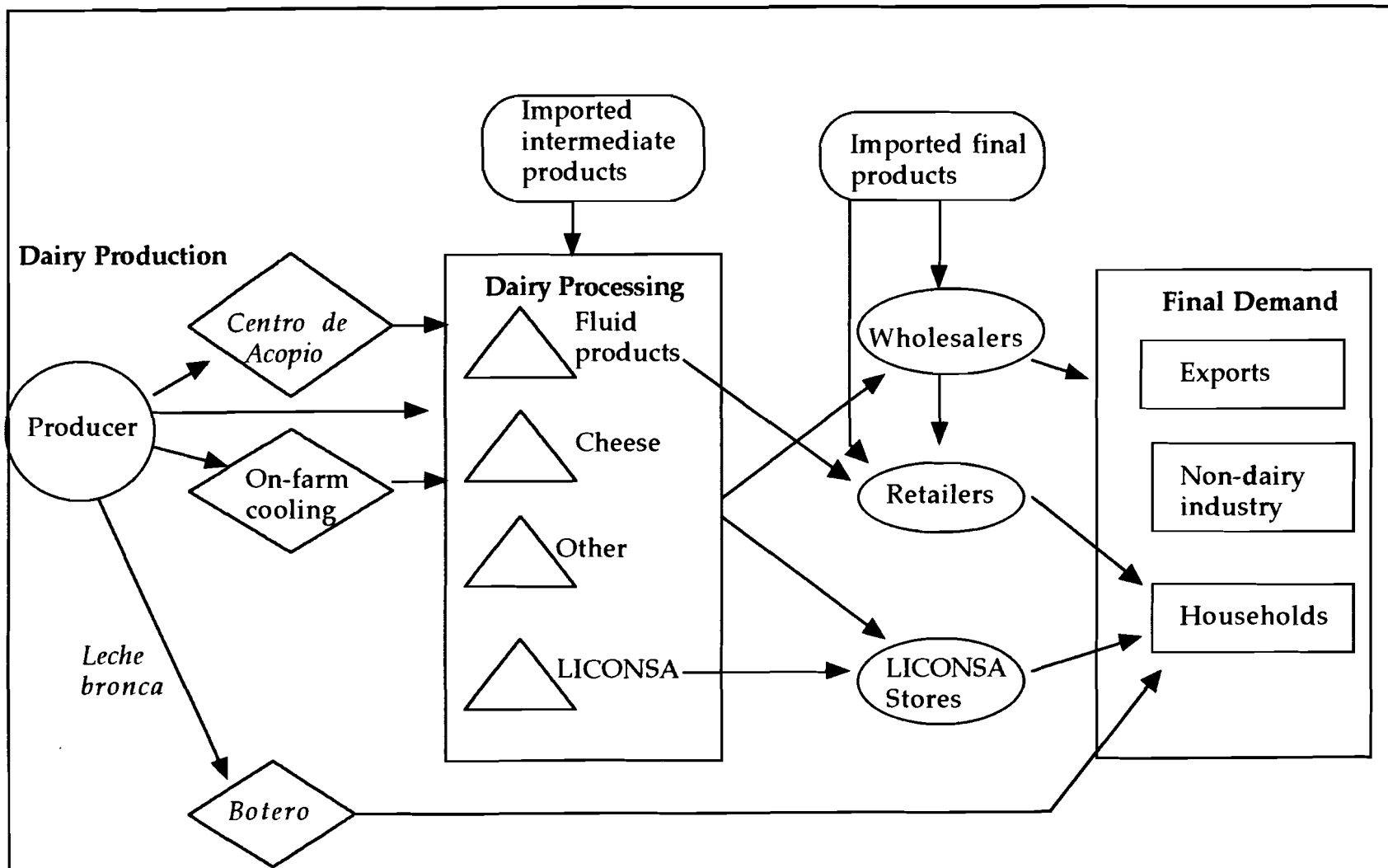

Figure 3. Sylized Depiction of Milk Marketing Channels in Mexico, early 1990s, adapted from del Rosario (1989) and Munoz *et al.*, 1991.

Adulteration of farm milk is reported to be common, although more prevalent for milk from semi-specialized and dual-purpose farms. Processors assert that farmers and transporters routinely dilute farm milk with water because they receive payment based on the volume of milk received at the plant. Boteros selling *leche bronca* directly to consumers are also alleged to water milk. Ultralácteos, a cooperative in Tabasco state, sent investigators to certain of its *centros de acopio* during 1994 due to the seriousness of this problem. Nestlé is moving to local chilling in part because it reduces the number of agents handling the milk (and therefore, the opportunities for adulteration) and makes the farmer more accountable for milk quality. Some dairy industry representatives opine that Mexico must adopt a component-pricing system if the adulteration is to be eliminated (Arturo Inda, industry consultant; Miguel García W. LICONSA, personal communications)[10].

In contrast to the US, much raw milk in Mexico is marketed through the "informal" channels, particularly in tropical regions (Figure 4). A study by ITESM (1994) estimated that 30% of all milk consumed in 1992, including the milk equivalents of imported dairy products, moved through the informal sector. Schulthies and Schwart (1991) stated that 30 to 50% of raw milk in Mexico was consumed *bronca* in the late 1980s. *Leche bronca*, defined here as unpasteurized fluid milk sold directly to consumers, probably accounts for no more than about 10% of domestic raw milk production as of 1994 (Arturo Inda, personal communication). Nevertheless, this 700 million liters is a significant share of the nation's milk supply and is enormous compared to the percentage of milk consumed on farms in the US.

What accounts for the high consumption of *leche bronca*? The *leche bronca* phenomenon is explained in part by restrictive retail price controls on fluid milk. Price controls provided incentives for farmers and small entrepreneurs to market milk directly to achieve a higher milk price. Simultaneously, cooperatives diverted milk from price-controlled fluid products to more profitable manufacturing products. In the tropics, the combination of urban centers with strong demands for fluid milk, the lack of "formal" infrastructure to process and transport fluid products[11], and the ability of informal marketing channels to evade price regulation contributed to growth in *leche bronca* marketing (Muñoz *et al.*, 1994).

Consumers' purchasing habits and their desire for "real" products also increased demand for *leche bronca*. The public was aware of allegations that some dairy cooperatives adulterated fluid milk products; vegetable fats and proteins, whey powder, and other extenders were used to lower costs of fluid products. Believing *leche bronca* to be "real and fresh", many consumers preferred *bronca* milk to pasteurized milk (Muñoz *et al.*, 1994). Ironically, sellers of *leche bronca* also adulterated milk. Although most retail price controls on fluid milk were relaxed

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[10] Similar problems existed in the US at the beginning of this century. They were largely eliminated by the advent of butterfat-based pricing, made possible by the Babcock test for milkfat.

[11] Fluid pasteurized milk is still not generally available in supermarkets in cities such as Villahermosa, although Ultralácteos, based there, produces UHT milk.

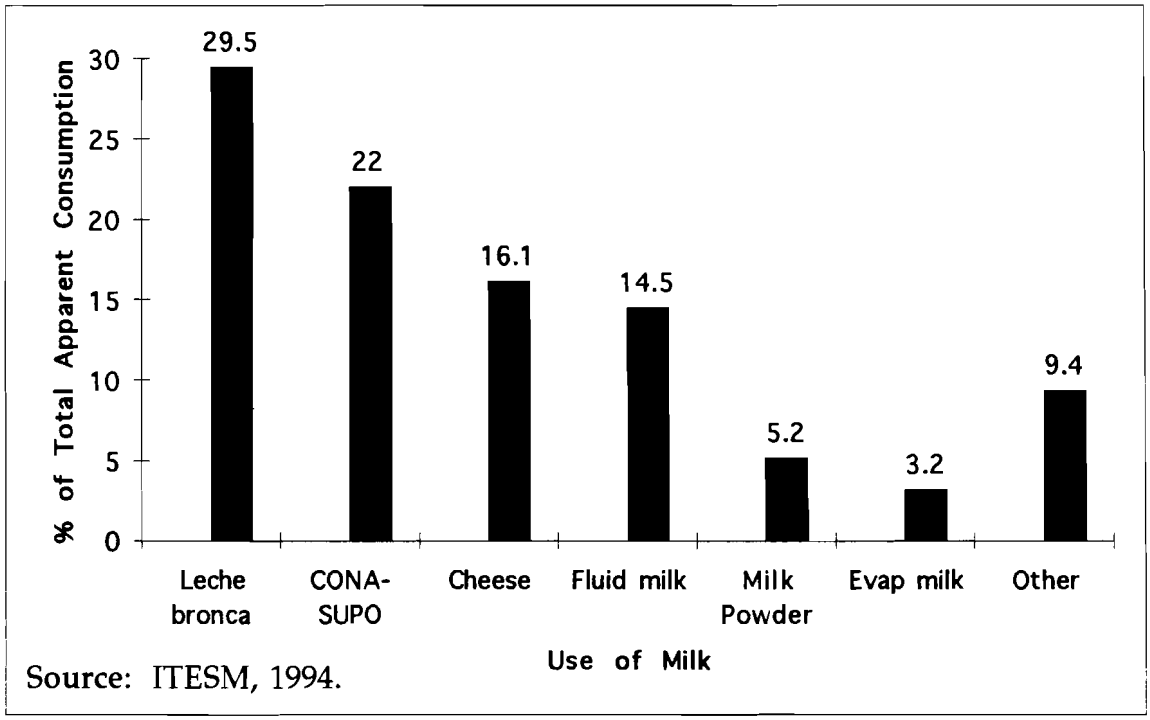

Figure 4. Estimated Utilization of Milk in Mexico Based on Total Apparent Consumption Including Imports, 1992

during the early 1990s, consumer purchasing habits continue to be shaped by the product perceptions that are their legacy.

The data on uses of domestically produced raw milk, as well as production of dairy products, are limited. In addition, major inconsistencies exist among information from different sources (Table 4). A recent study (ITESM, 1994) estimated that 41% of raw milk produced in Mexico was marketed through informal channels (Figure 4). According to this study, cheese manufacturers accounted for about 27% of domestic milk use, and fluid milk processors received 20% of domestic milk production. Relatively small amounts of milk were used for the manufacture of concentrated milks, yogurt, and other dairy products. CONASUPO and LICONSA, through their social programs, were estimated to market 22% of total Mexican consumption of dairy products (primarily reconstituted milk) in 1992 (Figure 4).

Table 4. Estimated Production and Imports of Selected Dairy Products, Mexico, 1992, Various Sources

Product	Source: USDA (1993)	NDPRB (1993)	Encuesta Industrial Mensual
Raw milk (000 lts)[1]	11,080	6,974	
Per capita (lts)	127.4		
Fluid products (000 lts)	4,716		1,827[2]
Butter (000 MT)			
Production	28		
Imports	12		
Total	40		
Per capita (kg)	0.5		
Cheese (000 MT)			
Production	390	212	7
Imports	20	24	
Total	410	235	
Per capita (kg)	4.7	2.7	
Ice Cream (000 MT)			
Production		105	
Imports		10	
Total		114	
Per capita (kg)		1.3	
Milk Powder (000 MT)			
Production	12		
Imports	212		
Total	224		
Per capita (kg)	2.5		
Yogurt (000 MT)			
Production		146	
Imports		8	
Total		154	
Per capita (kg)		1.8	

[1] Includes milk from cows and goats.

[2] Includes pastuerized milk, UHT milk, and reconstituted milk.

Processing technologies employed in the dairy marketing subsector are nearly as diverse as production technologies used on farms. The major cooperatives and Nestlé operate plants that in the US would be considered of large size, receiving over a million liters (2.2 million pounds) per day. Although the equipment used for some products (*e.g.*, cheese and milk powder) would not be considered "state-of-the-art", these plants use processes roughly similar to their US counterparts. Fluid milk processing, especially for UHT milk, often is comparable to that used in the US. Dairy product grade and sanitary regulations in Mexico are similar to (and sometimes stricter than) those in the US, but they are much less often enforced (Schulthies and Schwart, 1991). Indeed, plant visits by the author in 1994 suggest that sanitary standards, even in cooperative plants, are far from standardized. SARH (1992) emphasized the need to make milk quality standards more transparent to both consumers and producers. SARH and the Secretaría de Salud (SSA; the Secretariat of Health) planned to intensify actions to combat adulterations (SARH, 1992).

One key difference between dairy product standards in Mexico and the US is in the use of non-dairy components in dairy products. Vegetable fats are often used in conjunction with anhydrous milk fat and NDM to produce what are known in Mexico as "analog" cheeses[12]. Inda (personal communication) estimates that 50 to 75% of all cheese in Mexico is analog. Analog cheeses are legal so long as the products are appropriately labeled as analog. (This is apparently not always the case, however.) Dairy components (*e.g.*, NDM), vegetable fats, and vegetable proteins also can be used to make "milk-based nutritional beverages," provided the products are appropriately labeled. According to Inda (personal communication) these milk-based products combine high nutritional value and lower cost. Thus, they may better meet the needs of low-income consumers than "pure" dairy products.

However, there is widespread suspicion that some companies are using dairy and non-dairy components to reconstitute products later sold as fluid products. Some Mexican products sold as fluid or UHT milk contained vegetable fats and proteins (and antibiotic residues as well), according to tests performed by US dairy companies. Industry sources in Mexico indicate that up to 10% of fluid milk products may use whey powder as a milk extender (Sparks Companies, Inc., 1994), and "made to order" combinations of dairy components are imported specifically for such use (Arturo Inda, industry consultant, personal communication). US companies interviewed in mid-1994 considered less-than-favorable consumer perceptions of Mexican fluid milk products as a key to the growth in sales of packaged US fluid milk in recent years (Gary Corbett, Dean Foods, personal communication).

Two types of processing facilities predominate in Mexico's tropics: concentrated milk product plants operated by Nestlé and small cheese making operations. Small pasteurizing plants are found in Veracruz and Acapulco, and Ultralácteos in Villahermosa, Tabasco operates the largest UHT milk plant in the tropics. Nestlé pioneered the development of milk production in the tropics, and

[12] These cheeses would most often be called "imitation" cheeses in the US.

continues to operate plants in Chiapas and Veracruz that produce condensed, evaporated, and powdered milks. However, the majority of raw milk in the tropics not sold *bronca* is converted into cheese (Muñoz *et al.*, 1991).

Most of the tropical cheese plants are small, processing less than 20,000 liters of milk per day. Equipment is old, plants "ill-planned", and "know-how" is limited (Muñoz *et al.*, 1991). Tropical cheese production is highly seasonal, corresponding to the seasonality of milk production in the tropics. Significant excess capacity is common much of the year, and cheese makers report problems in acquiring milk and selling cheese due to seasonality. Much of the cheese is destined for local consumption; some varieties of cheese, such as *Crema Tropical* are produced and consumed almost exclusively in tropical areas. The use of the *tecnología de relleno* (process technology using non-dairy fats) by cheese makers in the altiplano and north and increased cheese imports are alleged to have hurt small cheese makers in recent years. However, other sources stated that increasing milk production in the tropics has increased the number of small cheese makers in the last 10 years (Roberto Saldaña, INIFAP, Mexico City, personal communication).

Dairy product distribution in the formal sector is similar to that in the US (Figure 5). Most of the cooperatives maintain wholly-owned local distribution networks for pasteurized fluid, yogurts, and some cheeses. These products are delivered directly to the supermarkets, corner groceries, and convenience stores that serve as the primary sales outlets for such products. UHT milk is more often distributed by wholesalers because of its longer shelf life.

Institutional arrangements between processors, wholesalers, and retailer differ between the US and Mexico. In contrast to US distribution systems, most supermarkets do not purchase fluid products directly from dairy processors. In addition, the wholesaler (distributor, food broker, importer, trading company, or manufacturer) is expected to provide direct store-door delivery, stock shelves, absorb "stales", and accept payment in 45-60 days (Wilson, 1995).

The distribution of pasteurized milk and yogurt in the north central and central regions of Mexico is greatly influenced by the large demand in Mexico City; an estimated 65% of all dairy products are consumed in the Mexico City area (José Luis Cruz, US Embassy/FAS, personal communication). Seventy percent of raw milk produced in Aguascalientes state, for example, is processed and shipped out of state; much of this milk is consumed in Mexico City (José Andrade de A., Gilsa, personal communication).

Because cheese production is more dispersed, cheese distribution from both formal and informal cheese makers relies more on a network of wholesalers. This wholesale network is often affiliated with central wholesale markets for primary foodstuffs, or *centros de abasto* (Figure 5) located throughout the country. Wholesalers distribute to a variety of local market outlets such as municipal markets, *mercados sobre ruedas* ("markets on wheels"), small grocers (*abarroteros*), and other smaller wholesalers (*varilleros*).

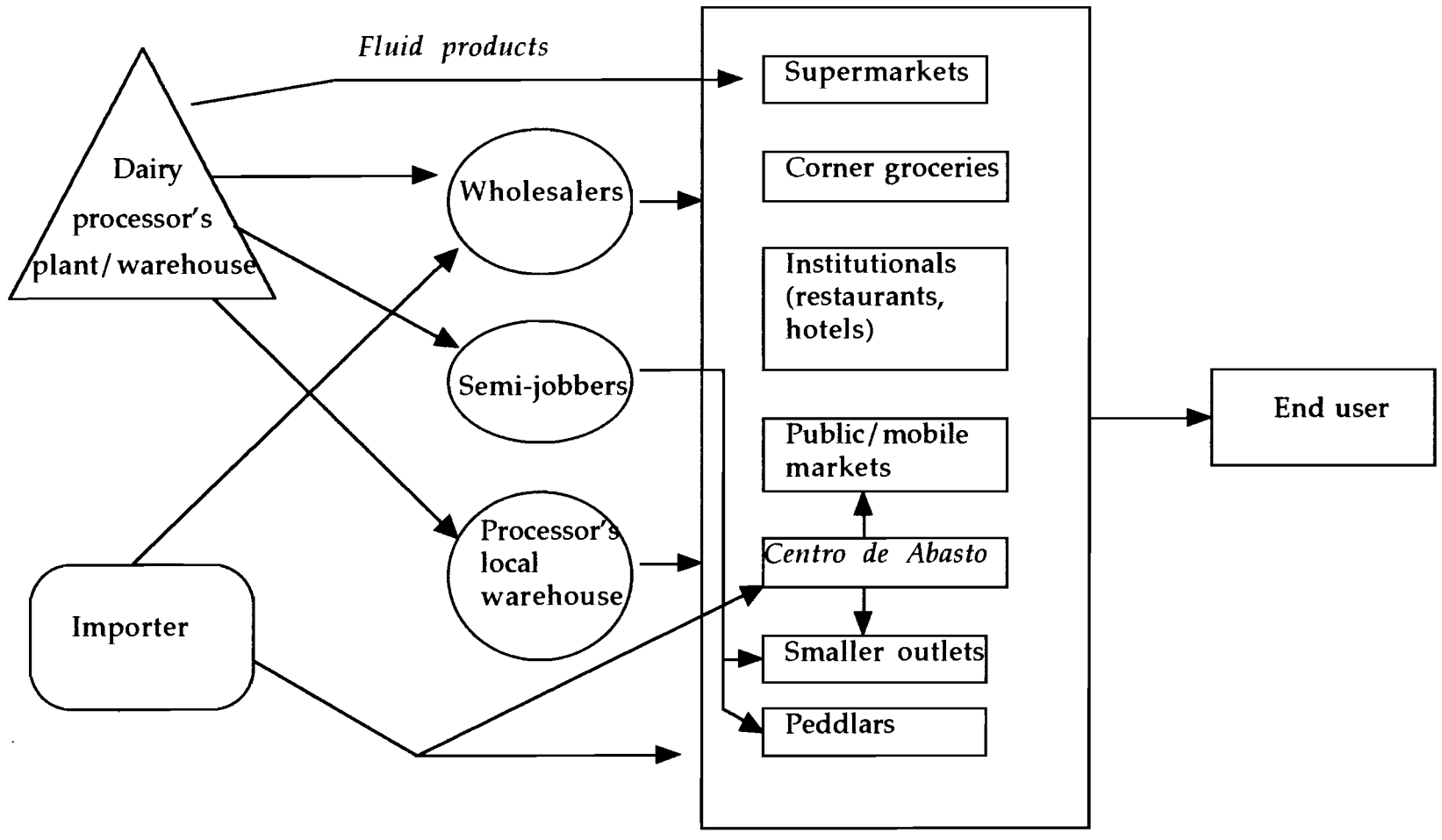

Figure 5. Stylized Depiction of Distribution Channels Used by Mexican Dairy Processors and Importers, early 1990s, adapted from USDA/FAS/ATO (1993b).

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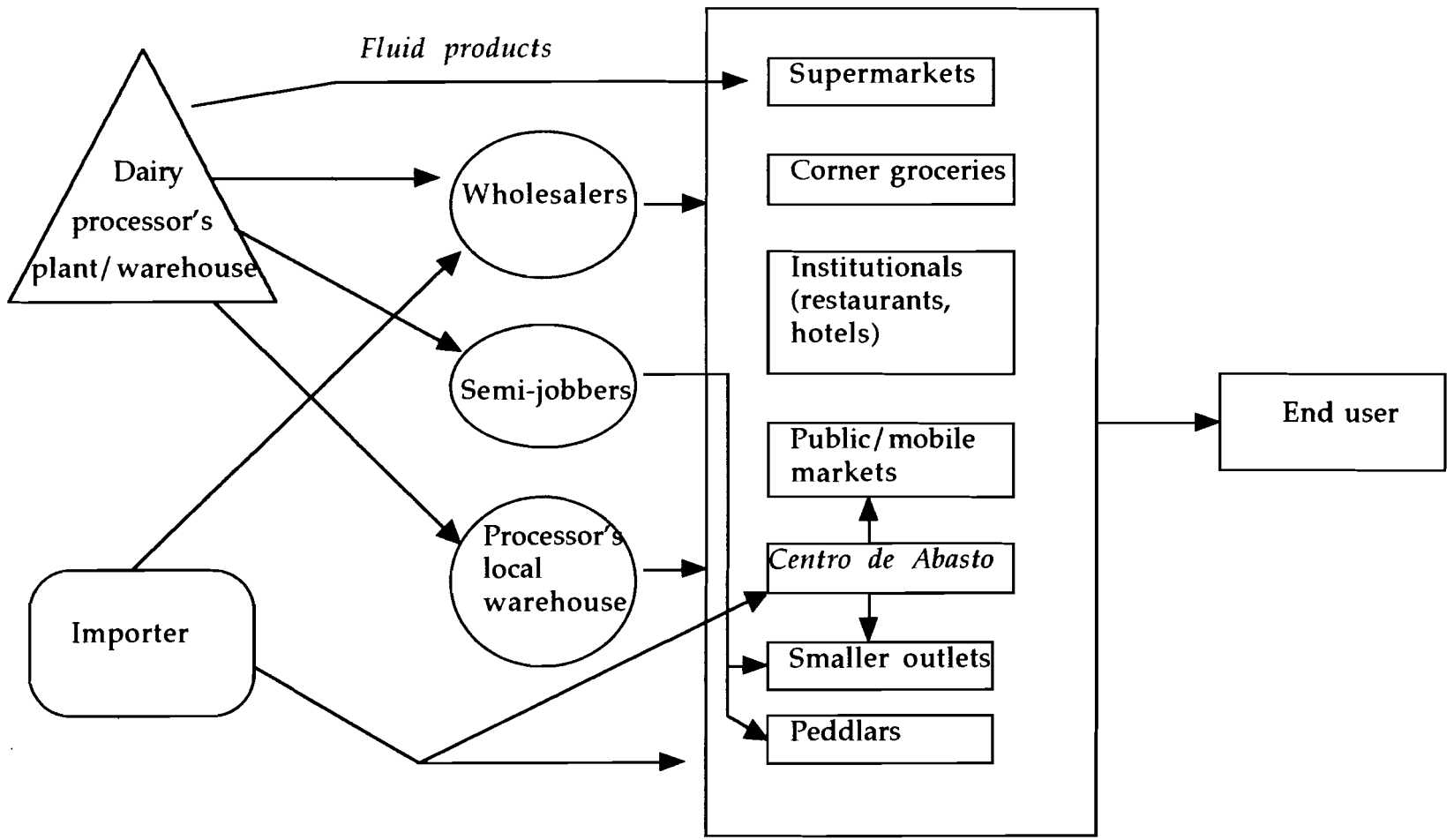

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Most ice cream distribution is local. High costs for transportation of frozen dairy products, and the tendency of Mexican consumers to purchase ice cream in "dip shops" has resulted in a very large number of ice cream plants serving local markets. However, some US ice cream is sold in supermarkets as far south as Mexico City, some 1,600 kilometers from the border. Mexico has sufficient refrigerated warehouses for the current volume of frozen food sales, but capacity must grow if consumption of frozen dairy products is to expand (Blalock, 1994).

A variety of retailers and institutional buyers provide the final link in the marketing chain between processors and consumers. Supermarkets in Mexico are often "hypermarts" stocking thousands of square meters of floor space with food dry goods, clothing, and appliances. A few regional supermarket chains dominate the market. The chains allegedly apply large mark-ups to many dairy products, and extract "slotting fees" from processors, a practice common in the US as well. Smaller neighborhood grocery stores are still common, but competition with supermarkets in recent years has reduced their number. Municipal and street markets, where many of the lower-income consumers shop, are important distributors of UHT milk, cheeses, and sometimes yogurt. Institutional buyers such as hotels and restaurant chains are increasing in importance, but remain relatively small players in the market.

Little published information exists on the costs of processing and distributing dairy products in Mexico. Processing costs are often assumed to be higher than those in the US because smaller plants and low plant utilization (60% for pasteurized milk in 1992, SARH) limit economies of scale in processing. The difference between producer and consumer fluid milk prices provides some indication of processing and distribution costs for pasteurized milk. In 1992, the consumer milk price averaged about two times the producer price (USDA/FAS, 1992), similar to the 2.25 ratio between retail and producer prices in New York State (New York State Department of Agriculture and Markets, 1993). The national average wholesale price of pasteurized milk (INEGI, 1993b) averaged 1.9 times the national average producer price (USDA/FAS, 1992)

Processing and distribution costs for manufactured products are less easily inferred than that for fluid milk products. Small cheese makers in Mexico's tropics received an average of 13 to 55% of the final retail price, whereas post-farm costs accounted for about 60% of powdered products manufactured by Nestlé (Muñoz *et al.*, 1991). NDPRB (1993b) estimated an average 40 to 50% mark-up of imported products to cover distributor's and retailer's margins, although retailers mark-up flavored UHT milks as much as 65% over wholesale prices (NDPRB, 1993a).

Policies Affecting the Dairy Marketing Subsector

Producer and retail price controls dominated discussions of policies affecting the dairy marketing subsector in the early 1990s (Muñoz, 1990). The survival of dairy processing companies in the late 1980s appeared to depend on their ability to lower processing costs (often through use of non-dairy components, legally or extra-legally), and to diversify product mix to products not price-controlled (such as UHT

rather than pasteurized milk). Price controls contributed to declining product quality, diversion of raw milk to manufactured products (thus promoting consumption *of leche bronca*) and forced closures of a number of pasteurization plants (Muñoz, 1990; Chauvet S., 1990). Tropical cheese makers were hurt by their inability to adopt the *tecnología de relleno* that allowed altiplano cheese makers to lower cheese production costs.

In the early 1990s, retail price controls were removed on products other than fluid milk, and the government announced its intention to remove the remaining price controls in the near future. However, retail price controls still existed as of mid-1994 for 1-liter containers of pasteurized milk, and some cooperatives were under government pressure to ship pasteurized milk to supermarkets where the price controls were more easily enforced (Victor Gavito, Alpura, personal communication).

A second policy with significant impact on dairy marketing is LICONSA's *Programa de Abasto Social*. This program distributes 3.5 to 4.0 million liters of milk per day to families with children under the age of 12 earning less than two times the minimum salary (800 to 1200 N$ per month, or $242 to $363 per month at mid-1994 exchange rates). The families receive a card entitling them to purchase 4 liters per child per week of milk for a fraction of the controlled retail pasteurized milk price. About 7 to 12% of the milk processed by LICONSA is raw milk purchased from farmers in the Altos de Jalisco, Tlaxcala, and Veracruz, where the agency sometimes serves as a "buyer of last resort". However, the vast majority of LICONSA's milk sales are from reconstituted imported NDM and vegetable (coconut and palm) oil. (Note that these vegetable oils are higher in saturated fats than milkfat.) The agency accounted for over three-quarters of NDM use in Mexico in 1992, up from about 25% in 1982 (SARH, 1992).

LICONSA distributes the reconstituted milk through its own retail outlets (*lecherías*). Over 50% of the *lecherías* are located in Mexico City and surrounding areas, as are 49% of program beneficiaries (INEGI/CONAL, 1993). Reconstituted milk distribution is concentrated in rural areas; LICONSA also distributes 240-gram sachets of WMP, primarily in rural areas. Nearly all of the WMP imported by Mexico in recent years (about 57,000 MT in 1992) went to this purpose. In 1992, LICONSA specified a goal of providing subsidized milk to all eligible families (some 12 million people) by the year 1994. Although few data are yet available, it is unlikely that this goal was achieved. Prospects for expanding the coverage of the *Programa de Abasto Social* are clouded by the recent exchange rate crisis, although government statements in early 1995 have indicated a willingness to push forward with the expansion (Miguel García W., T. C. Jacoby, personal communication).

The principal impact of LICONSA's social program on the dairy marketing subsector has been to increase Mexico's demand for imported NDM. However, LICONSA's sales of its three main processing facilities in the early 1990s to private industry, and its withdrawal from other "market-regulating" activities, may promote additional competition in the country's dairy processing industry. LICONSA's social program may have hurt producers in the semi-specialized

production system because program beneficiaries are those who might have purchased *leche bronca* from producers in the absence of the subsidy program. (Muñoz, 1990).

CONASUPO, LICONSA's parent agency, also performs a key role in Mexico's powder markets. As mentioned previously, CONASUPO controls all imports of NDM and WMP. The roughly 30% of NDM not used by LICONSA's social programs currently are auctioned to private industry monthly or quarterly, depending on need. In the late 1980s, CONASUPO apparently provided NDM to domestic processors at subsidized prices (Muñoz, 1990), but now appears to be extracting quota rents by selling to domestic processors at prices above world market prices.

The impacts of CONASUPO's control of NDM on the private dairy processing industry are difficult to assess in their entirety. Import quotas administered by CONASUPO undoubtedly raise the cost of NDM for a domestic industry that uses the product extensively. However, some companies have begun to import other forms of dairy components (dried buttermilk is an example) that can provide better "functionality" in processing and are not subject to import controls. In addition, some industry analysts suggest that smuggling of NDM and other forms of dairy components is widespread.

Sanitary grades and product standards, or rather, the lack of their enforcement, also influence the dairy marketing subsector. Stricter enforcement of product standards would undoubtedly pose a challenge to Mexico's regulatory agencies (principally to SARH and SSA). Enforcement of sanitary codes for Mexican processing plants would increase processing costs in many plants, although some plants, particularly in the border areas, might currently come close to meeting US standards.

The lack of standards enforcement has had two principal outcomes. First, dairy products in Mexico fall outside of established product norms more frequently than do their counterparts in the US (Miguel García W., LICONSA, personal communication). In addition to the use of non-dairy components, antibiotic residues in fluid milk products are alleged to be common. Whole milk with fat contents of 2.5 to 2.8% (below the product norm) has been reported (Miguel García W., LICONSA, personal communication). As a result, imported products have often been regarded by certain segments of the population as "better" or "more pure" simply because consumers do not trust the quality of domestic products. Although evidence from some supermarket surveys has indicated the contrary (IMOP/Gallup, 1993a; 1993b; 1993c), product quality perceptions appear to have contributed to increased imports of dairy products (often more expensive than domestic products) from the US and other countries.

The Future of the Dairy Marketing Subsector

Competition unleashed by trade and investment liberalization under NAFTA will have the greatest impact on Mexico's dairy marketing subsector in the next decade. Tariff reductions and liberalization of the trucking industry promise

greater availability of imported dairy products in Mexico at lower prices (the recent fall of the peso notwithstanding). Reform of investment regulations, and the strapped-for-capital condition of Mexico's dairy cooperatives, portend greater direct investment in dairy processing by foreign firms. As domestic dairy companies continue to shake off the legacy of price controls, competition based on product quality will take on greater importance. Mexico's dairy companies will likely become more responsive to changing consumer demands resulting from (longer-term) income growth.

A key unanswered question is the degree to which US and Mexican dairy companies will compete or cooperate in the future. Muñoz *et al.* (1994) noted that

> Northamerican [US] firms that are currently exporting products to Mexico have the capacity to augment their sales by developing their own distribution channels and introducing their own transportation into Mexico. Competition is expected, above all, from the southwestern US.

In fact, US companies have contracted with Mexican distributors *and* begun developing their own distribution, especially since 1990. A company in southern California routinely ships raw milk and ice cream novelties to Baja California Sur. Bulk milk from Texas travels to plants near Mexico City, and packaged milk from Houston, Harlingen, and El Paso are being retailed to consumers in Mexico City and Cancún (Wilson, 1995). Dean Foods has established a supply contract for packaged fluid milk with one of the fast-growing chains of "club" stores. Wal-Mart and K-mart have established "supercenter" stores as joint ventures with the largest Mexican supermarket chains. To support these efforts, the National Dairy Promotion and Research Board (funded by US dairy producers) has commissioned studies of the Mexican dairy market, sponsored US-product promotions in Mexico, and offered seminars on "How to Export to Mexico" for US companies. These efforts probably have increased Mexican imports of US value-added products.

Other dairy companies have pursued opportunities for joint ventures, mergers, or multinational operations in dairy product processing, sometimes in addition to increasing export sales to Mexico. The incentives for more direct involvement in dairy processing and distribution in Mexico may be large. Malanoski (1994) noted that more US food companies are establishing production subsidiaries in other countries to increase control over quality and presentation of the product in foreign markets (especially for branded products), and to enhance the ability of the firm to produce a product suited to the customer's needs and preferences.

The incentives described by Malanoski (1994) apply to US dairy companies considering doing business in Mexico:

> For dairy processing and distribution in Mexico, future joint ventures by US processors, food brokers, distributors, and third-party providers of logistics services with their Mexican counterparts are expected to become a major trend...driven by the need to provide close

> involvement in refrigerated and frozen distribution handling quality...(Wilson, 1995, p.23)

The Mexican Investment Board has encouraged foreign direct investment, and included a dairy company in its promotional literature about successful investments in Mexican food processing (Mexican Investment Board, 1992).

Representatives of a number of US companies have expressed interest in joint ventures with Mexican companies. Borden, Carnation, Hershey, I Can't Believe It's Yogurt and Kraft have established affiliates in Mexico, but total direct investment in dairy processing by US companies is less than $7 million (Bolling and Valdés, 1994). US companies are currently working to establish a network of at least one dozen public refrigerated warehouses (PRW) and other warehousing and distribution facilities (Blalock, 1994). The New Zealand Dairy Board also operates a wholly-owned subsidiary in Mexico, and Nestlé has maintained a lengthy presence as the largest single private dairy company in Mexico.

A joint venture between Mid-America Milk Producers (the largest dairy cooperative in the US) and a Mexican company exemplifies another strategy combining domestic processing versus export promotion. In 1994, Mid-American Milk Producers signed an agreement to build a bottling plant in Tepic, the capital of Nayarit state. The raw milk is to be shipped from the US, processed into pasteurized milk at the Mexican plant, and sold to consumers in the local and Guadalajara markets. Cream will be shipped back the US. The plant was scheduled to open in April 1995.

The dramatic nature of developments in Mexico's dairy product distribution should not be underestimated. Wilson (1995) notes that:

> With the post NAFTA phase-in of Mexican access for US motor carrier operations, increasing availability of Mexican equity investment opportunities including truck leasing, and the growth of refrigerated and frozen produce sales, a brand new national market for refrigerated and frozen distribution and logistics services is being built virtually from scratch. (Wilson, 1995, p.28).

The fall of the peso in late 1994 and early 1995 may make foreign companies less enthusiastic about direct investment in Mexico's dairy sector. Many US companies feel that direct investment is likely to increase because the long-term prospects for consumption of their products remain good, even if the economic growth in Mexico is slow for the next couple of years. The legal changes of the recent past, growing markets for higher-value food and beverage products have continue to suggest increased direct investment by foreign companies in Mexico (Bolling and Valdés, 1994).

How will Mexican dairy companies respond to increased competition from exports and joint ventures? A study by ITESM (1994) suggested that dairy markets will become even more regionalized, *i.e.*, that Mexican companies will increasingly orient themselves to satisfying regional markets. This strategy will reduce transportation costs, and allow the companies to retain their "base" marketing areas.

However, Mexican companies' response to explosive growth in imports of US yogurt in the early 1990s illustrates a different response. Deftly alerting Mexican consumers to the differences in US and Mexican yogurt styles and flavors[13], Mexican companies played a role in the decline of yogurt imports from the US between 1992 and 1993. Fluid milk promotions in Baja California in 1994 achieved a measure of success by emphasizing the nutritional value of "whole" milk produced in Mexico compared to that of "lowfat" milk from the US (*i.e.*, the ads depicted US milk as being of lower quality). The need for awareness of Mexican consumer preferences may also promote foreign investment in processing facilities, especially for products other than fluid milk , NDM, and AMF.

Changes in the retail sector are also likely to force changes in dairy product processing and distribution. Despite the importance of the "informal" retailing sector (municipal markets, mobile markets, small groceries), the growing purchasing power of the middle class means that the "formal" retail sector (supermarkets and convenience stores) is poised for sustained growth (Gras and Fraschetto, 1994). As formal retail outlets grow in importance, the nature of dairy products demanded by consumers is already changing (IMOP/Gallup, 1993a; 1993b; 1993c). Increased shopping in formal retail outlets is likely to modify consumer preferences towards better quality products, greater variety, and improved packaging, forcing responses from dairy processors.

Dairy Product Consumption in Mexico

The demand for dairy products determines most outcomes in Mexico's dairy marketing and production subsectors. Dairy product demand in Mexico comprises final demand by consumers, industrial demand within and outside of the dairy industry, and small export sales of dairy products. Empirical estimates of the size of Mexico's dairy product markets, as well as responsiveness of demand for dairy products to income and price changes, vary considerably and often are unreliable. Most consumption figures, for example, are arrived at by addition of estimated production (often very rough estimates) and imports.

Such consumption figures ignore the intra-industry use of dairy products forms (especially NDM and cream) and the substitutability of dairy components used to meet demands for "final" dairy products (*i.e.*, household demand and non-dairy industry use of dairy components). For example, summing imports and domestic production of NDM provides an indication of total NDM use in Mexico, but it ignores the uses to which that very adaptable product is put. Relatively little NDM is consumed directly by households; most is reconstituted, made into cheese, or processed into condensed milk products. Thus, most "consumption" of NDM is intra-industry, and is therefore driven by demands for "final" dairy products and possibilities for substitution among various sources of dairy components.

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[13] For example, most Mexican yogurts are "stirred" or "drinkable", whereas US yogurts are more often "flan" style; fruit-at-bottom yogurts tended to confuse Mexican consumers used to yogurts with fruit already mixed in.

Dairy product consumption by households is, of course, influenced by demographic factors such as population growth, per capita income level and distribution, urbanization, and age distribution. Mexico's population was estimated as 87 to 92 million persons in 1992, with growth of 1.85% per year. Thus, by the year 2010 the country will be home to some 121 million people and a majority of those citizens will be 20 years of age or less. Seventy percent of Mexican citizens, some 61.5 million people, lived in urban areas in 1992, and urbanization continues to increase. The fastest growing regions according to the 1990 census were the states of Mexico, Baja California Sur, Querétaro, Aguascalientes, and Campeche. Each of these regions had annual growth of greater than 3.5%. Already, one in four Mexicans lives in or around Mexico City, and an estimated 65% of dairy products are consumed in the Valle de México.

The combination of a young, rapidly growing population and increasing urbanization has led to estimates of strong dairy product demand growth in future years (Harris and McClain, 1991; National Dairy Promotion and Research Board, 1993d). However, income growth and distribution will also play a role in defining dairy product consumption in future years. Some 64% of Mexico's population earned incomes of less than 4 to 9 times the minimum salary[14]; nine percent are classified as upper class (incomes more than 20 to 90 times the minimum wage), and 27% are considered middle class (between 4 and 13 times the minimum wage). Consumption of dairy products is, not surprisingly, concentrated in upper income classes. SARH (1992) estimated that more than 65% of pasteurized milk, butter, cream, and cheese were consumed by the 40% of the population with the highest incomes. Data from the *Encuesta Nacional de Ingreso y Gastos de los Hogares* (ENIGH; INEGI, 1993), indicate that consumption is less concentrated in the upper income classes than SARH (1992) estimated, except for fluid milk (Table 5)

A number of authors have commented that Mexico has a serious nutritional problem rooted in inappropriate agricultural and income distribution policies (Adelman and Taylor, 1990). In 1992, over 11% of Mexican citizens were malnourished, and 1% of the population was considered "severely" malnourished (INEGI/CONAL, 1993). With the exception of social programs providing subsidized milk to low-income consumers, dairy products appear to play little role in meeting the nutritional needs of many low-income consumers. Surveys in 1992 indicated that only 10% of households in the lowest income decile consumed fluid milk products or *queso fresco*, and less than one percent consumed butter (Table 5).

[14] Socioeconomic class is defined based on income and the population of the community in which the household resides. Smaller towns have lower income thresholds to reach higher socioeconomic levels. The minimum wage in 1993 was about $1.16 per hour (National Dairy Promotion and Research Board, 1993a).

Table 5. Household Expenditures on Dairy Products, by Income Decile, *Encuesta Nacional de Ingreso y Gasto de los Hogares* Data (INEGI, 1993), Mexico, 1992.

Product	Income decile:										
	I	II	III	IV	V	VI	VII	VII	IX	X	Mean
Total Expenditure[1]	845.3	1463.6	2017.3	2425.7	2912.5	3478.1	4046.4	5158.0	6854.3	14287.5	4348.9
Fluid pasteurized											
% consuming[2]	10.0	21.9	37.1	47.5	53.3	57.8	59.5	64.6	69.3	73.3	49.4
Expenditure[1]	7.7	19.8	34.5	50.4	59.2	73.1	88.4	109.0	120.5	163.4	72.6
Budget share[3], %	0.9	1.4	1.7	2.1	2.0	2.1	2.2	2.1	1.8	1.1	1.7
Leche bronca											
% consuming[2]	9.1	11.8	11.4	10.1	13.6	12.0	13.3	12.3	12.0	7.3	11.3
Expenditure[1]	8.2	12.8	14.5	14.4	22.9	19.9	24.4	27.3	31.7	25.2	20.1
Budget share[3], %	1.0	0.9	0.7	0.6	0.8	0.6	0.6	0.5	0.5	0.2	0.5
Evaporated or condensed milk											
% consuming[2]	1.1	4.0	4.0	2.9	4.6	6.8	6.2	3.5	9.8	7.4	5.1
Expenditure[1]	0.6	1.6	5.3	1.6	3.0	4.2	4.8	2.7	8.4	7.3	3.9
Budget share[3], %	0.1	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Milk powder											
% consuming[2]	4.9	6.5	8.5	7.3	8.8	8.0	3.7	5.1	6.9	5.4	6.5
Expenditure[1]	6.6	7.8	10.2	9.0	15.5	16.1	7.2	9.5	13.9	13.0	10.9
Budget share[3],%	0.7	0.5	0.5	0.4	0.5	0.5	0.2	0.2	0.2	0.1	0.3
Queso Fresco											
% consuming[2]	10.2	16.0	26.5	24.3	27.3	28.4	26.9	33.2	30.9	25.5	24.9
Expenditure[1]	8.8	11.4	19.4	19.6	19.2	23.2	23.0	30.6	31.5	39.1	22.6
Budget share[3], %	1.0	0.8	1.0	0.8	0.7	0.7	0.6	0.6	0.5	0.3	0.5

Table 5 (continued)

Product	Income decile:										
	I	II	III	IV	V	VI	VII	VII	IX	X	Mean
Cream											
% consuming[2]	2.1	3.2	8.3	8.3	12.2	13.1	15.0	15.1	20.0	19.6	11.7
Expenditure[1]	1.3	1.4	4.4	3.3	6.3	5.7	7.5	7.4	9.7	13.5	6.0
Budget share[3], %	0.2	0.1	0.2	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.1
Butter											
% consuming[2]	0.9	1.0	1.9	3.2	4.3	4.4	4.6	6.1	8.4	9.7	4.5
Expenditure[1]	0.1	0.2	0.4	0.7	1.0	1.1	1.5	2.3	3.1	3.7	1.4
Budget share[3], %	0.02	0.02	0.02	0.03	0.04	0.03	0.04	0.05	0.05	0.03	0.03
Other[4]											
% consuming[2]	3.8	5.7	10.9	12.2	16.9	16.1	18.0	22.6	27.7	34.7	16.9
Expenditure[1]	2.2	3.4	7.0	9.3	12.2	12.4	17.5	24.3	36.7	57.8	18.3
Budget share[3], %	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.4	0.4

[1] Expenditure per household, in thousands of old pesos. In 1992, $1 equalled about 3,100 old pesos.
[2] Percentage of all households in the income decile reporting consumption of the product.
[3] Expenditure per household on product divided by total expenditure per household times 100.
[4] Includes cheeses other than *queso fresco*, yogurt, and other products not specified.

In contrast, however, other analysts have noted that Mexico's recent food consumption patterns (especially by high-income consumers) mark a "cultural conversion" (Wilson, 1995). Historically, food purchasing patterns in Mexico have reflected a "fresh food" and "shop, prepare daily" consumer mentality similar to that in the US prior to World War II. Recent explosive growth in supermarket sales of refrigerated, frozen, pre-prepared foods indicate a significant break with traditional purchasing patterns. Whereas the transformation of consumer preferences to more convenient and value-added food products required some 40 years in the US, the transformation in Mexico is expected to take place in 10 to 15 years (Wilson, 1995).

Per capita income also influences aggregate consumption of dairy products. Gross Domestic Product (GDP) per capita in Mexico was $3,800 in 1992, about 16% of the US level. Per capita consumption of most dairy products, with the exception of total use of NDM, was considerably lower in the Mexico than in the US (NDPRB, 1993b). Falling real incomes in Mexico during the first half of the 1980s resulted in precipitous (and long-lasting) declines in consumption of fluid milk products. This is consistent with estimated income elasticities for pasteurized milk and butter in 1992 of 1.01 and 1.18, respectively. Consumption of other dairy products declined less (and sometimes increased), consistent with estimated lower income elasticities (Table 6).

Dairy product prices relative to incomes also affect consumption. Retail prices of dairy products in Mexico City were lower than in many other major cities of the world in 1994. However, dairy product prices relative to average wages were among the highest in the world (Traub, 1994).

The nature of dairy products consumed by households, and in some cases, their place of purchase differ in Mexico and the US. The importance of *leche bronca* purchased from *boteros* in the aggregate consumption of fluid milk has already been mentioned, but other differences exist. Two percent and lowfat pasteurized milks are much less demanded in Mexico than is whole milk. Consumption of flavored UHT milk in 250 ml Tetra-pak™ containers has "skyrocketed" in the past five years, and now one liter of flavored UHT milk is sold for every twelve liters of white milk sold (NDPRB, 1993a). Significant sales of reconstituted milk by LICONSA and what are essentially "milk-based nutritional beverages" by other companies contrast sharply with the extremely limited market for such products in the US.

Butter and cream in Mexico are superficially similar to their counterparts in the US, but often contain up to 50% vegetable fat even if the use of vegetable fat is not indicated on the label (Arturo Inda, personal communication). Yogurt is one of the few products for which Mexican per capita consumption is close to US per capita consumption. However, "blended" and drinkable yogurts are most popular; "set", non-fat and fruit-at-the-bottom yogurts are purchased less often.

Table 6. Estimated Expenditure Elasticities[1] for Eight Dairy Products in Mexico, by Income Decile, 1992.

Product	Income decile:										
	I	II	III	IV	V	VI	VII	VII	IX	X	Mean[2]
Fluid pasteurized	3.56	2.02	1.42	1.08	1.02	0.91	0.80	0.72	0.71	0.48	1.01
Leche bronca	0.80	0.69	0.71	0.76	0.50	0.60	0.49	0.42	0.29	-0.51	0.59
Evaporated or condensed milk	3.08	1.54	0.52	1.85	1.02	0.75	0.65	1.09	0.26	-0.59	0.78
Milk Powder	0.45	0.49	0.41	0.48	0.28	0.25	0.52	0.28	0.03	-1.29	0.32
Queso Fresco	0.78	0.84	0.58	0.62	0.67	0.59	0.61	0.46	0.42	-0.09	0.62
Cream	1.63	2.12	0.83	1.22	0.72	0.87	0.71	0.80	0.67	0.45	0.91
Butter	2.76	2.55	2.08	1.34	1.12	1.25	1.06	0.84	0.82	1.33	1.18
Other	1.78	1.86	1.36	1.23	1.13	1.34	1.11	1.02	0.91	1.23	1.14

[1] Expenditure elastcities were estimated using a simplification of the method of Hazell and Röell (1983). Their method involves estimating the equation:

$$w_p = \alpha_p + \beta_p \cdot \left(\frac{1}{E}\right) + \gamma_p \cdot Ln(E) + \varepsilon_p,$$

where w_p is the budget share of total expenditures on product p and E is total expenditures per household. Household demographic characteristics, included by Hazell and Röell, are omitted here because only data for the decile means were available. With this estimation, the expenditure elasticities are calculated as:

$$\eta_p = \frac{\alpha_p + \gamma_p \cdot (1 + Ln(E))}{w_p}.$$

Because expenditures vary with income decile, elasticities can be calculated for each decile.

[2] Elasticities computed at the mean for all households of budget share and total expenditures.

[3] Includes cheeses other than *queso fresco*, yogurt, and other products not specified.

Mexico's many cheese plants produce over 20 principal varieties of cheese, some of which have few counterparts in other countries. *Queso fresco* (fresh cheese) dominates Mexican consumption, accounting for an estimated 79% of the cheese market in 1989 (NDPRB, 1993b). Analog *queso fresco* (made with caseinates, NDM, and AMF) is estimated to account for between 45 and 75% of total *queso fresco* production (NDPRB, 1993b; Arturo Inda, personal communication). Thus, analog cheeses predominate in the Mexican market.

A second general category of cheese, *queso blanco* , is characterized by a lack of maturity, white color, and mild taste. Real and analog *Manchego* and *Asadero* (often not clearly distinguishable from a similar cheese *Oaxaca*) are the principal *queso blanco* varieties; they accounted for about 8% of cheese production in 1989. Closely related to Manchego and Oaxaca cheeses, *Queso Chihuahua* is usually matured for less than a month; its composition and flavor resemble that of a mild cheddar in the US.

Relatively small amounts of cottage cheese and ricotta cheese (*requesón*) are consumed in Mexico. Matured hard and semi-hard cheeses is less than 1% of total cheese production, most consumption of ripened cheeses is provided by imports. Real and analog process cheeses account for approximately 10% of domestic cheese production; imported cheese is often used to manufacture process cheese. A variety of fresh and slightly matured cheeses, such as *Crema Tropical, Queso de Sal, Guaje de Bola,* and *Queso de Poro* , are produced and consumed primarily in Mexico's tropics (Villegas de G., 1993).

Ice cream is a popular snack and dessert food in Mexico; push cart vendors and "dip shops" are common in major cities. Some 40% of ice cream production is artisanal, most of it produced from NDM and coconut oil (NDPRB, 1993b). The largest manufacturer of ice cream in Mexico, Grupo Quan, reportedly uses fresh milk and cream to manufacture ice cream. Recent consumer surveys indicate that ice cream is still regarded as an "impulse item" to be consumed away from home. However, home refrigeration continues to grow from low levels and supermarket sales of ice cream are increasing.

Dairy processing operations are significant "intermediate" consumers of dairy products, especially of NDM, whey powder, casein (or caseinates), and anhydrous milk fat. The most significant use of NDM is for reconstituted milk, but NDM and AMF are also used to make concentrated milk products, ice cream, and analog cheeses. Whey powder is allegedly used as an "extender" for fluid milk and certainly is used to produce ice cream, yogurt, analog cheese, and process cheeses. Casein and caseinates (all imported) are used in cheese production. The importance of dairy processors as intermediate consumers implies the need to track the sources and uses of dairy components to avoid double counting in consumption estimates.

Non-dairy industries are also important consumers of dairy components. NDM, whole milk powder, and whey powder are used extensively in prepared mixes for the baking and confectionery industries. Significant percentages of whey and whey powder are used to make commercial animal feeds or are fed directly to animals. Whey concentrates and lactose are also used by vegetable oil processors,

baby food manufacturers, and the pharmaceutical industry. Button manufacturers use imported casein in limited amounts. Quantitative estimates of non-dairy industry demand are difficult, but the demand is probably small relative to aggregate demand by households. Nevertheless, economic analyses of Mexico's dairy sector must account for industrial demand for dairy components.

Estimates of dairy product consumption in Mexico, conforming to the pattern for all other quantitative information about the country's dairy sector, vary considerably by source and method (Table 7) Estimated fluid milk consumption, based on production plus imports, equaled about 86.0 liters per capita in 1992. Consumption of fluid products based on household expenditure surveys and contemporaneous prices amounted to 43.1 to 58.4 liters per person, only one-half to two thirds of the 86.0-liter figure. Differences in estimated consumption of similar magnitudes exist for milk powder, cheese, and butter. Estimated per capita consumption of ice cream and yogurt from different sources vary although the method used to calculate consumption is the same.

Consumption of dairy products by households, the dairy industry, and non-dairy food processing industries vary from region to region in Mexico, although limited data are available to delineate regional differences. Dairy product consumption by households differs in part due to differences in regional per capita income. In 1989, per capita income by state ranged from $1,000 in Oaxaca to $7,000 in Mexico City. It is thus no surprise that Mexico City is believed to consume the lion's share of dairy products. A 1993 survey indicated that consumers in lower income categories purchased less yogurt and cheese in supermarkets than higher income households (IMOP/Gallup, 1993a; 1993b; 1993c).

Anecdotal evidence from dairy processing companies indicates regional differences based on climate and refrigeration systems as well. In the altiplano, better refrigerated transport systems and higher proportions of households with refrigerators mean higher per capita consumption of products requiring refrigeration, such as pasteurized fluid milk, yogurt, and ice cream. In Mexico's tropics, consumption of UHT milk is more common due to lack of refrigeration, and some grocery stores carry little if any pasteurized milk. Regional tastes and preferences also differ; some cheese varieties are unique to the tropics, and due to the tropical climate, one processor remarked, "people in the tropics prefer to drink beer."

The uncertainty about magnitude and regional differences in estimated consumption suggest two great needs. The first need is for better general information about the size and nature of Mexico's dairy markets; a number of previous authors have noted this (*e.g.*, Harris and McClain, 1991; SARH, 1992). The second need is for sensitivity analysis in economic modeling of Mexico's dairy sector, to assess the importance of differing consumption estimates to predicted outcomes of the sector's future.

Table 7. Estimates of Dairy Product Consumption in Mexico, early 1990s

Product, source of estimate	Per-capita consump-tion	Method to estimate	Source
Fluid Milk	86.0 lts	Domestic fluid milk production + fluid milk imports+ NDM use	USDA/ FAS/ATO, 1992
	75.5 lts	Domestic fluid milk production + fluid milk imports, no NDM use	USDA/ FAS/ATO, 1992
	72.9 lts	Fluid milk, leche bronca, and milk equivalents sold by LICONSA; includes imports	ITESM, 1994
	43.1 - 58.4 lts	INEGI household expenditure surveys and prices from USDA (1992); includes pasteurized and unpasteurized milk	INEGI, 1993a; USDA /FAS, 1992
	52.6 lts	Fluid milk for domestic consumption	USDA/ FAS, 1993a
	47.2 lts	Unspecified	Knutson *et al.*, (1991).
Milk Powder	2.2 kg	Total domestic use	USDA/ FAS, 1993a
	1.5 kg	Domestic production + NDM imports	NDPRB, 1993a
	1.1 kg	Domestic production + NDM imports	USDA/ FAS/ATO, 1992
	0.9 kg	NDM, evaporated milk, and condensed milk; includes imports	ITESM, 1994
	0.5 - 0.6 kg	INEGI expenditure surveys and prices from USDA (1992); includes NDM and whole milk powder	INEGI, 1992; USDA/ FAS, 1992
Cheese	4.8 kg	Domestic production + imports	USDA/ FAS/ATO, 1992
	4.7 kg	Unspecified	Knutson *et al.*, 1991

Table 7 (continued)

Product, source of estimate	Per capita consump -tion	Method to estimate	Source
Cheese, continued	4.6 kg	Domestic production + imports	USDA/ FAS, 1993a
	2.8 kg	Unspecified	NDPRB, 1993a
	2.0 kg	Total milk equivalents consumption of 110 kg times 15.99% to cheese, divided by milk requirement of 9 liters milk per kg cheese	ITESM, 1994
	1.3 kg	INEGI household expenditure surveys and prices from USDA (1992); includes only fresh cheeses	INEGI, 1992; USDA/ FAS, 1992
Butter	0.5 kg	Unspecified	NDPRB, 1993a
	0.5 kg	Total domestic use	USDA /FAS, 1993a
	0.4 kg	Unspecified	Knutson *et al.*, 1991
	0.1 - 0.2 kg	INEGI household expenditure surveys and prices from USDA (1992)	INEGI, 1992; USDA/ FAS, 1992
Ice cream	1.3 kg	Estimated production + imports	NDPRB, 1993a
	1.2 kg	Estimated production + imports	USDA/ FAS/ATO, 1992
Yogurt	1.8 kg	Estimated production + imports	NDPRB, 1993a
	1.1 kg	Estimated production + imports	USDA/ FAS/ATO, 1992

Policies Affecting Dairy Product Consumption

The principal policies influencing dairy product consumption in Mexico, retail price controls and the *Programa de Abasto Social* operated by LICONSA, have already been discussed in some detail. The aggregate result of these programs, and the overvaluation of the peso in recent years, was to subsidize consumers of dairy products. Consumer subsidy equivalents (CSEs)[15] in the late 1980s amounted to as much as 16% of the consumer price (Hallberg *et al.*, 1992). Price controls accounted for about 40% of total subsidies (although with the adverse effect of reducing production of pasteurized milk), and LICONSA's social program accounted for nearly all of the remaining subsidy. The predominate effect of consumer subsidies on consumption has been to increase consumption of reconstituted milk, and perhaps of *leche bronca.*

Future Growth in Dairy Product Consumption

Growth of per capita income and population will in large measure determine growth in aggregate consumption of dairy products in Mexico during the next two decades. The distribution of income, accessibility of home refrigeration, and forces influencing consumer preferences (*e.g.* marketing) will affect the composition of dairy products consumed. LICONSA's ability to pursue its stated goal of doubling recipients of subsidized reconstituted milk will also influence future consumption of fluid milk products.

Population growth, often easier to predict than income growth, is expected to remain above 1.8% per year for the foreseeable future. Thus, unless per capita incomes fall dramatically, aggregate consumption of dairy products can be expected to grow on the order of 2% per year. Increases in per capita income will increase per capita consumption of dairy products, but by varying amounts. Based on estimated income elasticities (Table 6), income growth will increase household demand for butter, pasteurized milk, cream, and "other" dairy products more than the demand for *leche bronca*, milk powder, and *queso fresco*. Total dairy product demand and its composition will also depend on distribution of income growth in future years. Because low-income consumers are estimated to have higher income elasticities of demand for dairy products (Table 6), dairy product demand increases will be greater, the greater are the percentage income gains by households in the lower deciles. (The converse is also true, that is, dairy product demand can be expected to fall by a larger amount if low-income consumers suffer a larger percentage drop in real income. Recent evidence suggests substantial drops in real income for many Mexican consumers as a result of the recent crisis.)

Thus, in the longer term, income growth should modify the composition of Mexican dairy product consumption. Demand for cheese, butter, high quality fluid

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[15] Consumer subsidy equivalents are the amount of income that consumer would need to be compensated if all government programs in effect at the time of the measurement were removed. A positive CSE indicates that government programs subsidize consumers.

products should increase, replacing reconstituted and analog products (Harris and McClain, 1991). Increases in yogurt and flavored UHT milk sales during the period 1990-94 are consistent with this observation. However, the major dairy cooperatives as of mid-1994 (before the peso plunged) foresaw few changes in the composition of dairy product consumption in Mexico, at least in the next five years ("Unfortunately not," lamented one cooperative manager).

Most estimates of aggregate growth in dairy product consumption range from 2 to 4% per year until the year 2000 (Harris and McClain, 1991; ITESM, 1994). However, all of these estimates were offered before the recent exchange rate crisis. Greatly increased peso prices of imported dairy products, the government's commitment to fiscal austerity, and feeble economic growth in the next couple of years are likely to alter both aggregate growth of dairy product consumption and slow the trend towards increasing consumption of value-added and imported dairy products.

Mexico's Trade in Dairy Products

Mexico emerged in the 1980s as one of the principal dairy importers in the world. In 1992, imports provided more than 20% of aggregate dairy product consumption (based on milk equivalents)[16] in Mexico (Muñoz *et al.*, 1994). Mexico imports everything from bulk fluid milk to ripened French cheeses, but NDM is by far the most important import. Imports of NDM totaling $334 million per year accounted for well over 60% of the value of annual imports during 1990-93 (Table 8 and Figure 6)[17]. Butteroil (anhydrous milkfat) and cheese accounted for an additional $61 million and $57 million per year, or about 22% of the total value of imports. Thus, most of Mexico's imports correspond to "intermediate" products used by the dairy industry to manufacture other products, especially reconstituted milk for the *Programa de Abasto Social.*

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[16] As with all other dairy market statistics for Mexico, trade data differ by source. I have chosen to cite data originally from Banco de México, complied by a private consulting firm Grupo PM, and as reported by the Confederación Nacional Ganadera. I acknowledge that obvious errors, omissions or inconsistencies exist in the data from these sources, and that they differ from data compiled by USDA. However, they provide more detailed product and country categories than do other sources.

[17] Massive imports of NDM are not a recent phenomenon. In 1980 and 1981 large quantities of imported NDM were used to support the *Sistema Alimentario Mexicano* (SAM). NDM imports dropped dramatically in 1982 due to the loan crisis, but rebounded in 1983. By the end of the decade annual imports of NDM had surpassed the previous peak of 237,000 metric tons achieved in 1980.

Table 8. Volume and Value of Mexico's Imports of Intermediate and Final Dairy Products, 1990-93

	1990		1991		1992		1993		Avg. 1990-93		Growth. 1990-93	
	Vol (000 MT)	Value ($ mil)	Vol (000 MT)	Value ($ mil)	Vol (000 MT)	Value ($ mil)	Vol (000 MT)	Value ($ mil)	Vol (000 MT)	Value ($ mil)	Vol (%)	Value (%)
Intermediate products												
Fluid milk, whole [1]	3.6	1.3	7.7	3.8	17.3	6.0	18.4	5.7	11.8	4.2	413.5	344.9
Fluid milk, skim[1]	2.0	1.4	2.6	1.7	2.7	1.6	2.2	1.4	2.4	1.5	8.7	-4.2
Skim milk powder[2]	153.1	295.4	39.6	72.9	96.1	175.5	190.4	335.0	134.6	243.6	24.3	13.4
Whole milk powder[2]	134.7	259.0	19.2	35.3	58.7	101.1	42.4	73.8	63.7	117.3	-68.5	-71.5
Buttermilk[3]	14.0	19.5	8.8	11.4	8.7	13.4	5.2	7.5	9.2	13.0	-62.7	-61.4
Butteroil	26.8	47.8	34.1	57.0	38.0	68.2	39.6	67.6	34.6	60.1	48.1	41.6
Whey products[4]	2.2	2.7	7.3	4.6	20.1	17.7	21.1	12.9	12.7	9.5	877.0	375.9
Cream[5]	20.3	7.8	24.3	10.6	23.8	13.6	35.7	16.1	26.1	12.3	76.1	107.2
Evaporated or condensed milk[1]	0.2	0.2	0.4	0.3	0.2	0.2	0.1	0.1	0.2	0.2	-42.5	-42.5
Total, intermediate products (value only)		635.0		197.6		397.3		520.1		461.4		-18.1

Table 8 (continued)

	1990		1991		1992		1993		Avg. 1990-93		Growth. 1990-93	
	Vol (000 MT)	Value ($ mil)	Vol (000 MT)	Value ($ mil)	Vol (000 MT)	Value ($ mil)	Vol (000 MT)	Value ($ mil)	Vol (000 MT)	Value ($ mil)	Vol (%)	Value (%)
Final products												
Fluid milk, whole[6]	17.6	7.5	30.5	14.4	40.3	19.4	43.3	21.5	32.9	15.7	145.4	187.4
Fluid milk, skim[6]	6.7	3.5	5.9	3.1	5.0	2.5	3.8	1.8	5.4	2.7	-42.7	-48.2
Cream[6]	2.6	1.7	3.4	2.0	5.8	2.8	10.0	4.9	5.4	2.9	285.1	197.0
Evaporated and condensed mlk[6]	1.2	1.5	0.2	0.3	1.0	0.8	1.0	1.3	0.8	1.0	-16.0	-18.3
Yogurt	12.4	4.1	5.5	6.1	7.8	8.6	6.2	8.1	8.0	6.7	-49.7	98.1
Ice Cream	3.5	5.2	13.7	19.4	9.8	14.1	12.9	18.8	10.0	14.4	266.3	264.9
Butter	0.3	0.9	3.5	5.3	.6	1.4	.8	1.7	1.3	2.2	125.3	94.0
Cheese, total	9.8	29.3	15.8	35.0	21.0	56.8	29.5	76.0	19.0	49.3	200.9	159.2
Total, final products		53.6		85.7		106.0		134.1		94.9		150.0
Total, all products		688.6		283.3		503.3		654.2		556.3		-5.0
% of total import value												
Final products		7.8		30.3		21.1		20.5		17.1		
Milk powder		80.5		38.2		55.0		62.5		64.9		
Butteroil		6.9		20.1		13.6		10.3		10.8		

Source: Banco de México, Conferación Nacional Ganadera (1994).

[1] Product imported in non-hermetically sealed containers.

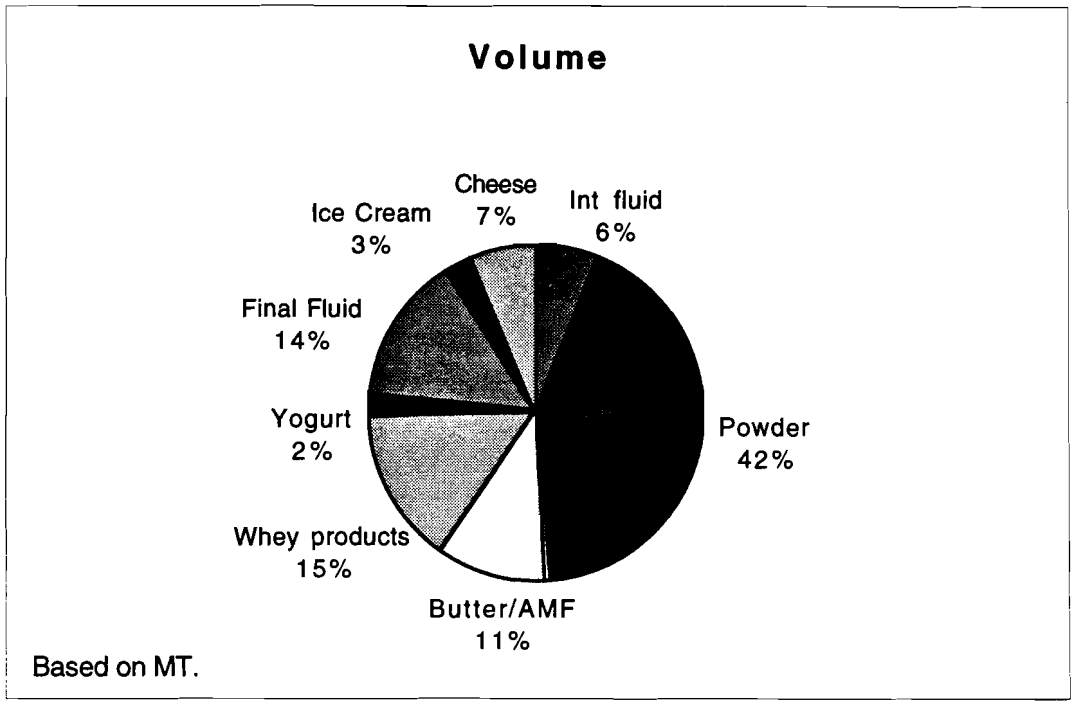
[2] Includes all imports of powdered milk products, although some quantities are imported for final consumption.

[3] Includes fluid and dried buttermilk, dried sour cream, sour cream with fat content greater than 45%, kefir, and related products. According to data from New Zealand Milk Products (México), S.A. de C.V., most imports in this category are dried buttermilk.

[4] Includes fluid and dried whey, whey protein concentrates, milk protein concentrates, and other articles of milk or cream.

[5] Includes cream in non-hermetically sealed containers and fluid sour cream with a fat content less than 45%.

[6] Product imported in hermetically sealed containers.



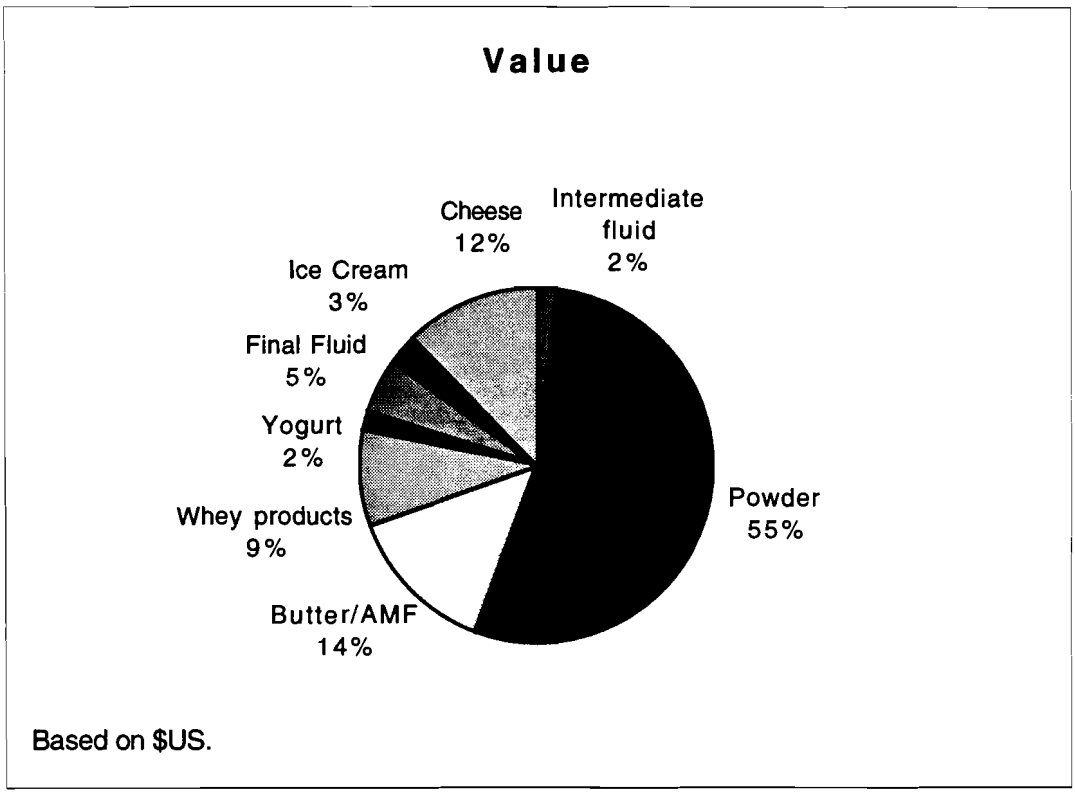


Figure 6. Distribution of the Volume and Value of Mexico's Dairy Product Imports, 1992.

Mexico's heavy reliance on NDM imports (combined with negative PSEs in the 1980s) spawned numerous proposals (none enacted) from producer associations for dramatic action to achieve "self-sufficiency" in milk production (Asociación Nacional de Ganaderos Lecheros, 1988). The self-sufficiency movement reached a crescendo in the late 1980s, when milk powder prices on the world market rose from about $800 per MT to nearly $2,200 per MT. At that time, producer associations and others decried the country's reliance on "highly variable" and "subsidized" world markets for "basic food commodities," suggesting that it would be cheaper and safer to produce the milk domestically (Muñoz, 1990). After 1990, world prices for powder fell from their 1988-89 peaks, and producers focused greater efforts on securing more favorable terms for their industry in the NAFTA and GATT negotiations.

The majority of imports to Mexico are government-to-government sales, or sales subsidized by the US or the European Union (EU). However, private traders are playing an increasingly important role (Harris and McClain, 1991). The US has sold Mexico butter, butteroil, cheese, and NDM under PL 480 (Title II) and Section 416 food donation programs. In the last few years, Mexico has been an important destination for NDM exports under the US Dairy Export Incentive Program (DEIP). During 1990-93, Mexico purchased about 44% of intermediate product imports from the EU (Table 9). New Zealand, Australia, and Uruguay are the only significant exporters to Mexico that employ few or no subsidies.

The majority of NDM and AMF exported to Mexico during 1990-93 originated in the EU, although the US and New Zealand also supplied significant quantities of these commodities. New Zealand and the EU supplied 94% of whole milk powder imports, which averaged about 63,700 metric tons (MT) per year during 1990-93. The US has been the predominate supplier of other "intermediate" products in recent years, accounting for nearly all sales of bulk fluid milk and cream, and nearly two-thirds of whey product exports (Table 8). Canada's exports to Mexico comprise relatively small amounts of NDM and whey products.

The US is also the principal supplier of "final" dairy products to Mexico, supplying close to 100% of packaged fluid milk and cream, evaporated milk, yogurt, and ice cream sales. Overall, US products accounted for 55% of the total value of imported final products in 1990-93 (Table 9). The EU and the US sold about equal shares of evaporated milk to Mexico in recent years. New Zealand is the principal supplier of butter (to be distinguished from butteroil) to Mexico, providing about one-half of the value of imports in 1990-93. Mexico imports cheeses (primarily ripened cheeses) from many countries. For 1990-93, 34% of the volume of cheese imports originated in countries other than the US, the EU, New Zealand or Canada; the EU and US weighed in with 30 and 21% of cheese exports to Mexico, respectively.

Table 9. Value of Mexico's Imports of Intermediate and Final Dairy Products, 1990-93, by Country of Origin

	1990		1991		1992		1993		Average,1990-93	
	$ mil	%	$ mil	%	$ mil	%	$ mil	%	$ mil	%
Intermediate[1]										
EU	360	56.5	71	34.4	126	42.7	187	35.5	186	44.7
USA	76	11.9	84	41.1	100	34.0	170	32.4	108	25.9
South Pacific	185	29.1	38	18.5	28	9.6	98	18.7	88	21.1
Canada	15	2.4	9	4.3	27	9.3	13	2.5	16	3.9
Other	1	0.1	4	1.7	13	4.4	57	10.8	19	4.5
Total	637	100.0	206	100.0	294	100.0	526	100.0	415	100.0
Final[2]										
EU	10	19.3	10	11.2	19	17.9	34	25.7	18	19.3
USA	29	54.1	58	67.9	64	61.4	69	51.6	55	58.4
South Pacific	2	3.0	1	1.7	8	8.1	15	11.2	7	7.0
Canada	0	0.1	0	0.2	1	1.4	2	1.5	1	1.0
Other	12	23.5	16	19.0	12	11.2	13	10.0	13	14.3
Total	53	100.0	86	100.0	105	100.0	134	100.0	94	100.0
Total										
EU	370	53.6	80	27.6	144	36.2	221	33.5	204	40.0
USA	104	15.1	143	49.0	164	41.2	240	36.3	163	31.9
South Pacific	187	27.1	40	13.6	37	9.2	113	17.2	94	18.5
Canada	15	2.2	9	3.1	29	7.2	15	2.3	17	3.3
Other	13	1.9	20	6.8	25	6.2	70	10.7	32	6.3
Total	690	100.0	291	100.0	399	100.0	660	100.0	510	100.0

[1] Intermediate products include bulk fluid milk and cream, bulk evaporated and condensed milk, NDM, WMP, butteroil, buttermilk powder, whey products, and caseinates.

[2] Final products include packaged fluid milk and cream, packaged evaporated and condensed milk, yogurt, ice cream, butter, and cheese.

The value of intermediate product imports declined about 18% during 1990-93. Although care must be exercised in selecting initial and terminal points to evaluate the growth in imports, imports of whey powder and bulk fluid milk increased by 877 and 414%, respectively, during 1990-93. Increases in imports of AMF and NDM were 8 and 24%, respectively. A seventy-two-percent decrease in the value of whole milk powder imports offset the increases to produce the overall decline (Table 8).

Although NDM still dominates Mexican imports of dairy products, a number of analysts have noted what they see as the growing importance of imported value-added products (Muñoz *et al.*, 1994). The value of cheese imports (especially of grated/powdered and hard varieties) increased 201% from 1990 to 1993. Ice cream imports, although a smaller percentage of the value of total imports, grew even faster: 266% in four years. The value of imported packaged fluid milk and cream, yogurt, and butter all grew over 100% during 1990-93. Overall, the value of final imported products grew 50% in these four years (Table 8).

According to Muñoz *et al.* (1994) this trend is explained by the *aperatura comercial* (trade liberalization), seasonal scarcity of certain dairy products (and associated speculation), and failure of Mexico's domestic dairy industry to exploit its natural advantages in selected market niches. Attitudes of Mexican consumers may also explain the dramatic growth of value-added dairy products. Prior to Mexico's accession to GATT in 1986, few imported value-added dairy products were available in Mexico. Mexican consumers felt that many domestic products were of poor quality, and regarded imported products as preferable. With the lowering of trade barriers, consumers have flocked to buy imported products, simply because they were imported (Muñoz *et al.* , 1994; Luis Moreno, Grupo PM, personal communication). Consumer curiosity about imported products and low opinions about domestic dairy products in the early 1990s overcame prices as much as 80% higher for US fluid milk, yogurt, and ice cream (NDPRB, 1993b). This hypothesis is undermined to some extent by surveys of supermarket shoppers that indicate consumers prefer all attributes of Mexican cheese, yogurt, and ice cream to those of their counterparts imported from the US and Europe (IMOP/Gallup, 1993a; 1993b; 1993c). Clearly, though, perceptions of imported and domestic value-added products differ, and economic modeling of Mexico's dairy sector would be improved by differentiation of these products.

Despite the large percentage increases in final imported products during the early 1990s, intermediate products continue to account for over 80% of the value of imports (Table 8). The trend towards final products commanding a greater share of the value of imports in recent years is not evident for 1990-93, although assessing the trend is made difficult by year -to-year fluctuations in NDM imports of over $100 million.

Exports are rarely mentioned in discussions of Mexico's dairy trade, perhaps justifiably given their minuscule magnitude compared to imports. During 1993, Mexico exported over $5 million in powdered milk products, $2 million worth of evaporated and condensed milk, and about $500,000 of other dairy products. Some

processors in Mexico, including tropical cheese makers, hope to find markets for their products in the US (José Castillo G., Director of Cattle Industry Development, Tabasco State, personal communication). Gilsa, a dairy cooperative in Aguascalientes is seeking to expand exports of its fluid milk products to Central America.

Policies Affecting Dairy Trade

Mexico's trade policies have changed considerably since its accession to GATT, because policy makers in recent years have viewed trade liberalization as crucial to increased competitiveness of domestic industry and, therefore, economic growth. Prior to 1986, Mexico charged tariffs as high as 40% on imported dairy products, often requiring an import license as well. With membership in GATT, tariff rates were lowered to a maximum of 20% for dairy products, although import licenses were still required for NDM, evaporated milk, and fresh cheeses as of 1991 (Schulthies and Schwart, 1991). In addition, CONASUPO continued to control NDM imports, although the government has frequently stated its intention to privatize the NDM market.

Both NAFTA and the Uruguay Round agreement of GATT imply additional significant changes to Mexico's dairy trade policies. These two agreements will provide the backdrop against which future developments in Mexican dairy product trade will be played out. NAFTA provisions became effective January 1, 1994, and GATT provisions were scheduled to go into effect in 1995. However, the policies provided for by the two argreements are dramatically different.

NAFTA provisions fall into three main categories: market access, sanitary and phytosanitary, and rules of origin. Because Canada excluded its dairy sector from the NAFTA, these provisions will affect dairy trade only between the US and Mexico. NAFTA will result in the gradual elimination of all tariffs and non-tariff barriers immediately for some dairy products, and over a 10 to 15-year transition period for others.

The most important of the market access provisions concerns US exports of NDM to Mexico (Table 10). Under these provisions, Mexico converted its import licenses for NDM to a tariff-rate quota (TRQ), which will be phased in over 15 years. The US can ship up to 40,000 MT of skim milk powder to Mexico duty free under the TRQ. Imports of NDM over the quota were subject to an initial tariff of 139%, or not less than $1,160 per MT. The TRQ will be increased as the agreement is phased-in, and the "over-quota" tariff rate will be decreased to zero by 2009. Tariff rates for most other products will be frozen at previous levels and phased-out over 10 years (Table 10).

Table 10. NAFTA Provisions Regarding Mexico's Imports of U.S. Dairy Products

Product	Pre-NAFTA		Post-NAFTA		
	Tariff (%)	Import License	Initial Tariff	Phase-out	TRQ[1] (MT)
Milk or cream, unsweetened	10%[2]	No	10%	10 yrs	
Milk powder, fat content less than 3%	0%	Yes	139%[3]	15 yrs	40,000[4]
Milk powder, fat content greater than 3%	0%	Yes	10%	10 yrs	
Evaporated milk	10%	Yes	20%	10 yrs	
Condensed milk in:					
Hermetic containers	10%	No	15%	10 yrs	
Other containers	20%	No	20%	10 yrs	
Yogurt	20%	No	20%	10 yrs	
Fluid sour cream	20%	No	10%	10 yrs	
Other fermented milk products[5]	20%	No	20%	10 yrs	
Whey Products[6]			10%	10 yrs	
Butter	20%	No	20%	10 yrs	
Anhydrous milk fat	20%	No	0%	None	
Fresh cheese	20%	Yes	40%	10 yrs	
Grated or powdered cheese	20%	No	20%	10 yrs	
Processed cheese	20%	Yes	20%	10 yrs	
Ripened cheeses[7]	20%	No	20%	10 yrs	
Ice cream	20%	No	20%	10 yrs	
Caseinates	15%	No	15%	10 yrs	

[1] Tariff Rate Quota.

[2] Prior to 1994, no tariff was applied to fluid milk imports in the border zone.

[3] Initial over-quota tariff. Imports up to 40,000 MT enter without a tariff, but receive the price offered by CONASUPO.

[4] Increases 3% per year until the tariff is phased out in 2009. TRQs are not applicable to other products under NAFTA.

[5] Includes buttermilk, dried sour cream or buttermilk, and sour cream with a fat content greater than 45%.

[6] Includes fluid and dried whey, whey protein concentrate, milk protein concentrate, and "other articles of milk or cream".

[7] Includes most hard and semi-hard cheeses.

Sanitary and phytosanitary provisions concern the rights of NAFTA signatories to establish health, safety, and environmental standards for products entering their borders. NAFTA generally allows each country to maintain current health, safety, environmental, and product standards. State and local regulatory authorities may establish stricter standards, so long as these standards are considered "scientifically defensible," that is, they are not designed primarily to discourage imports. The most significant consequence of these provisions is that Mexico's dairy exports to the US must continue to meet the same health, sanitary and product standard regulations applicable to dairy products produced and marketed in the US.

Rules of origin limit export to other NAFTA countries of products containing components imported from non-NAFTA signatories. Of most concern to the US dairy industry, rules of origin were enacted as permanent legislation to ensure that Mexico did not become an export platform for dairy products from non-NAFTA countries. As a result, dairy products originating outside Mexico must be transformed significantly before receiving preferential tariff treatment under NAFTA. The agreement does not preclude Mexico from importing products or components from non-NAFTA countries for domestic consumption, while exporting Mexican-origin products to the US. Operational definition of origin provisions often requires lengthy legal processes (Boadu and Wise, 1993), so their impact on Mexico-US dairy trade is not yet fully known.

The changes wrought by the entry into force of NAFTA in January 1994 have resulted, paradoxically, in additional challenges for US exporters of dairy products. US fluid milk products formerly allowed tariff-free access to border zones were assessed a 9% tariff[18], and some states sought to prohibit entry of packaged fluid milk, accusing US exporters of introducing milk of "poor quality" (*El Mexicano*, Tijuana, Baja California, December 16, 1993). NAFTA's passage has increased border crossing documents and rules (Dan Conable, US Embassy, Mexico City, personal communication), and "many of the regulatory agencies...are being overly cautious in protecting themselves through extra-careful compliance enforcement" (Wilson, 1995). It continues to be the case that all sales into Mexico must be through a Mexican importing company, which is required to provide necessary SARH and SSA permits (Wilson, 1995).

Labeling requirements and product standards have taken on increased importance for Mexican regulatory agencies and dairy processors seeking to stem the flow of US imports. In June 1994, the Ministry of Trade and Industrial Development (SECOFI) announced proposed regulations concerning minimum commercial information on labeling of domestic and foreign products. Current law specifies that all products must bear a label in Spanish *prior to being placed on the market* (NDPRB, 1994). This allows Spanish-language "stickers" to be applied to products after importation by the distributor or retailer. The proposed regulations may require dairy products to bear a Spanish-language *label* (*i.e.*, not just a "sticker"). Some US companies have seen this labeling requirement as a potential barrier to US

[18] In addition, some US companies claim they have had to pay what amount to bribes for their product to enter Mexico.

exports due to the cost of developing separate labels (and sometimes processing runs) for a relatively small proportion of their total sales.

In addition, some Mexican dairy companies have sought to bar US products using product standards. Mexican companies have filed complaints against US yogurts on the grounds that they do not meet Mexican standards for live bacterial cultures. Fluid milk processors in Mexico have sought, without success to date, to subject packaged US milk products to the same shelf-life regulations as Mexican pasteurized milk products, 48 hours. Although the major supermarkets, who import significant quantities of US packaged milk, have opposed this restriction, it illustrates the continuing efforts to use NAFTA provisions concerning grades and standards to limit trade.

Mexico's GATT commitments mark another paradox in the trade liberalization game. Under the Uruguay Round Agreement, Mexico will be allowed to *increase* tariff rates for nearly all products from less than 20% to 50% (Table 11). Tariff rates on most products will be lowered to 37.5% over ten years, resulting in an effective increase in trade barriers for dairy products from countries other than the US. Nonfat dry milk imports from countries other than the US will receive a TRQ of 80,000 MT annually, with an over-quota tariff of 139% (or a minimum of $1,160 per MT). Fresh cheeses will be similarly protected. The TRQ for NDM will be increased about 3% per year, but the over-quota tariff will only be reduced to 125.1% in 2004.

The Future of Dairy Trade

Mexico's dairy trade patterns are inextricably linked to the other complex interactions in the country's dairy sector. Thus, the growth of raw milk production and dairy product demand, economic growth, and changing consumer preferences towards prepared foods will greatly influence the magnitude and composition of imported dairy products in future years. The value of the peso in international currency markets, conditions in world markets for bulk dairy products, and Mexico's commitment to its *Programa de Abasto Social* will also affect the number of container ships and tanker trucks that enter Mexican territory laden with dairy products. Marketing strategies decided upon by competing foreign and domestic dairy processors, wholesalers, and retailers to stay abreast of changing consumer preferences will influence dairy imports as well. The diversity and complexity of the interactions resulting in dairy trade patterns render accurate predictions difficult.

However, a number of studies, most conducted by US universities and interest groups prior to the passage of NAFTA, have estimated the potential for US exports to Mexico. Schulthies and Schwart (1991) predicted large increases in bulk and packaged fluid milk sales from the southwestern US if Mexico's per capita consumption of fluid milk grew to equal that of the US by 2000. Harris and McClain (1991) predicted that a production deficit amounting to as much as 100% of 1993 production by the end of the decade implied that Mexico would be a large and growing market for imported dairy products with or without NAFTA. Hallberg *et al.* (1992) also foresaw a widening gap between milk production and consumption in

Table 11. GATT Provisions Regarding Mexico's Imports of Dairy Products from Countries Other Than the US

Product	Pre-GATT		Post-GATT		
	Tariff (%)	Import License	Initial Tariff (1995)	Final Tariff (2004)	Initial TRQ[1] (MT)
Milk or cream, unsweetened	10%[2]	No	50%	37.5%	
Milk powder, fat content less than 3%	0%	Yes	139% or $1,160[3]	125.1% or $1,044	80,000[4]
Milk powder, fat content greater than 3%	0%	Yes	50%	37.5%	
Evaporated milk	10%	Yes	50%	45%	
Condensed milk	10%	Yes	87% or $200[5]	78.3% or $180	
Yogurt	20%	No	50%	37.5%	
Other fermented milk products[6]	20%	No	50%	37.5%	
Whey products[7]			50%	37.5%	
Butter	20%	No	50%	37.5%	
Anhydrous milk fat	20%	No	20%	18%	
Fresh , processed, or Colonia cheese	20%	Yes	139% or $1,160[3]	125.1% or $1,044	9,385
Cheese, grated/powdered	20%	No	50%	37.5%	
Ripened cheese[8]	20%	No	50%	45%	
Lactose	10%	No	50%	45%	
Ice cream	20%	No	50%	45%	
Caseinates	15%	No	50%	37.5%	

[1] Tariff Rate Quota.

[2] No tariff applied to fluid milk products in the border zone.

[3] Initial tariff rate is 139%, but not less than $1,160 per MT; final tariff rate is 12.1%, but not less than $1,044 per MT.

[4] Excludes US TRQ under NAFTA of 40,000 MT. The TRQ increases 3% per year until 2004.

[5] Initial tariff rate is 87% but not less than $0.20 per kg; final tariff rate is 78.3% but not less than $0.18 per kg.

[6] Includes buttermilk, dried sour cream and buttermilk, and sour cream with a fat content greater than 45%.

[7] Includes fluid and dried whey, whey protein concentrate, milk protein concentrate, and "other articles of milk and cream."

[8] Includes most hard and semi-hard cheeses.

future years. The best prospects for US exporters, according to this study, will be the NDM needed to reconstitute milk for social programs and AMF; they saw limited opportunities to increase US exports of soft manufactured dairy products, cheese, or butter.

A Component Balance for Mexico

Most previous studies of Mexico's sector have used milk equivalents to express both the country's dependence on dairy imports, and aggregate consumption of dairy products (Schulthies and Schwart, 1991; Harris and McClain, 1991; Muñoz *et al.* , 1994). The use of milk components may be misleading because of the importance of "intra-industry" demand for dairy products used in the process of making other dairy products, and because double-counting of components is the likely outcome.

A fundamental principle of most dairy processors is that milk is not "milk" once it reaches the processing plant. Rather, "milk" is a combination of components that can be separated, mixed and matched as it were, to create a plethora of products. Substitutability in sources and uses of components in various product forms is thus an essential characteristic of dairy product manufacturing processes. This is particularly true in Mexico, where dairy manufacturers employ significant quantities of non-dairy components in analog cheeses and other products.

As an alternative to a "milk equivalent" balance, which typically is based on a single component, a balance of each of several components is possible. A "multiple components" balance requires information on the component contents of raw milk supplies, domestic dairy products, and imported dairy products, in addition to quantities produced or imported. Selection of components for the component balance is arbitrary, because milk components can be categorized in nearly infinite ways. I have chosen seven components: dairy fat, vegetable fat, casein, non-casein proteins, other solids not fat or protein (primarily lactose and minerals), non-dairy solids, and water.

Component content, admittedly, must often be estimated because aggregate statistics are unavailable. However, component content estimates can be made for Mexico with approximately the same accuracy as estimates of total production or trade (Arturo Inda, industry consultant, personal communication), given discrepancies among sources of production and trade data.

A component balance for Mexico for 1992 (the base year for economic modeling of Mexico's dairy sector) indicates that country produced between 73 and 79% of the four dairy components it consumed (Table 12). Components from imported NDM accounted for between 0.3% (for fat) and 12.3% (for non-casein proteins) of the total sources of dairy components, in contrast to the 38% dependency on imports expressed as milk equivalents from Muñoz *et al.* (1994).

Note, however, that the component "balance," doesn't balance. This is to be expected based on the quality and independent sources of the data on production,

Table 12. Estimated Dairy Component Balance, Mexico, 1992

Component sources and uses	Fat	Casein	Non-Casein Proteins	Lactose minerals, salts	Water
	(000 MT)	(000 MT)	(000 MT)	(000 MT)	(000 MT)
Sources					
Raw milk	230.1	167.4	41.8	397.5	6,137.1
Imported products	75.1	62.5	12.6	108.1	109.7
Total, sources	305.2	229.8	54.5	505.6	6246.8
Uses					
Final product consumption[1]	235.4	215.8	54.3	496.8	6692.4
Difference	69.9	14.0	0.2	8.75	-445.6
% difference	22.9	6.1	0.4	1.7	-7.1
Imported components, % of total sources	24.6	27.2	23.2	21.4	1.8

[1] Includes household consumption, non-dairy industry demand, and exports of final products.

consumption, and trade. However, the "imbalance" provides a framework to better assess the (in)consistency of dairy market statistics.

The components balance to within acceptable accuracy (plus or minus six percent); the large excess of milkfat supplied is the notable exception[19] (Table 12). This large discrepancy in the supply and demand for milkfat is troubling and puzzling. The estimated surplus is 69,900 MT of milkfat, equal to a stunning 22.9% of the total sources of milkfat. Although some comfort may be found in realizing that this surplus is only half of the estimated use of vegetable fats in Mexico's dairy sector, no completely satisfactory explanation exists for this surplus. The search for an explanation must consider the possibility of both understated demand and overstated supply of milkfat.

[19] Water also does not balance, being in deficit rather than surplus. This is generally unimportant because water can nearly always be added at low cost to achieve a proper moisture content. Most of the imbalance is due to water added to whey to achieve a 7% solids content.

One possible explanation is that significant nondairy industry demands for AMF and butter exist. However, industry contacts in Mexico doubted that the demand for either AMF or butter by nondairy industries could account for 70,000 MT of milkfat. Another possible explanation is that butter demand by households is much higher than that estimated using ENIGH household survey data or by USDA's independent estimates. For this to fully account for the estimated discrepancy between uses and sources of milkfat, though, butter consumption would need to be over 170,000 MT, or nearly five times the current estimate of total butter demand.

Alternatively, the milkfat content of final products could be higher than that assumed in the calculations of component balance. Only certain products, however, account for a large enough proportion of milkfat usage for assumptions concerning their milkfat content to be within reasonable bounds. The most likely candidate is fluid pasteurized milk, yet the milkfat content of this product would need to be 5.2% (*i.e.*, higher than the content of raw milk) for milkfat sources and uses to balance. This seems particularly unlikely given the alleged widespread usage of vegetable fat in fluid milk products in Mexico, and the increasing consumption of lowfat milk products.

An additional possibility is a lower the milkfat content of raw milk supplied. In order for this to balance the sources and uses of milkfat, the fat content of raw milk must equal 2.32%. This seems implausibly low, particularly in light of the proportion of milk supplied by herds with lower milk per cow but often higher fat contents. Industry analysts in Mexico nearly all agreed that cow's milk in Mexico averaged 3.3% milkfat; there was more agreement on this than on most other issues or data. Thus, changing the milkfat content of raw milk independent of other changes seems unreasonable.

A final option to explain this striking milkfat imbalance is some combination of the above possibilities. A combination of higher nondairy industry demand for milkfat, higher milkfat content in fluid pasteurized milk, and lower milkfat content of raw milk supplies could balance milkfat sources and uses. However, the values of the individual parameters would generally fall outside acceptable ranges even when they are changed in combination, due to the large magnitude of the discrepancy. The large discrepancy in the estimated component balance for milkfat underscores the critical need for more detailed and reliable information about dairy markets in Mexico.

Concluding Comments

This bulletin has attempted to characterize the diversity of Mexico's dairy sector. This diversity certainly applies to the characteristics of the production systems, processing technologies, and consumption patterns in Mexico. However, diversity characterizes published dairy market statistics (*i.e.*, estimates of past and current production, consumption, and trade differ markedly by source) as well as opinions concerning the sector's future.

Without a doubt, numerous gaps and inconsistencies remain in the information about Mexico's dairy sector. Future studies of the dairy industry in Mexico could benefit from more reliable and comprehensive data on milk production and composition, dairy product consumption (including use of "intermediate" products by dairy and non-dairy industries), and costs in the marketing chain. Studies of costs and economies of scale in dairy processing like that of Stephenson (1990) would be of particular value to future researchers of Mexico's dairy marketing sector. An improved understanding of the responsiveness of producer and consumer decisions to prices would seem imperative. This would contribute not only to planning by Mexico's processing sector, but also to policy decisions by the Mexican government based on an improved understanding of welfare implications for producers, processors, and consumers.

Of course, the collection of these data would not be costless. Greater collaboration among future researchers of Mexico's dairy sector may help to spread the costs and benefits of data collection efforts specific to a particular research project. The government and private industry should probably take a greater role in supporting data collection as part of efforts to improve overall dairy marketing sector performance. Regionally disaggregated data on producer milk prices, dairy product prices, and consumption could be used by many producer and processor organizations to guide future decisions; such information would provide a better basis for dairy sector studies as well.

The foregoing descriptive analysis underscores the need for disaggregated empirical analyses of the dairy sector in Mexico and countries with similar dairy industry characteristics. Quantitative analyses of Mexico's dairy sector must reasonably represent at least four essential elements. The first of these elements is the spatial disaggregation of production, processing, and consumption; these activities are dispersed throughout the Mexican Republic. Second, disaggregation of dairy sector actions (or actors) into production, processing, and consumption is essential to understand the differential impacts of the changing economic environment on these groups, and to adequately represent policy instruments.

An appropriate representation of the bio-physical processes of dairy product manufacturing, including at a minimum the disaggregation of milk into its functional components, is a third necessity. This is particularly true in Mexico due to the extensive substitution of dairy and nondairy components in "dairy" products. A fourth essential element is the linkage between Mexico's domestic dairy markets and international markets for dairy products, given the country's heavy reliance on imports. With these essential characteristics in mind, researchers can provide information more useful to decision makers in the dairy industries and governments of both Mexico and the US, for it is their decisions that will truly shape future outcomes in Mexico's dairy sector.

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