



Department of Agricultural Economics  
Kansas State University

July 2003

---

## The U.S. Corn Masa Industry: Structure and Implications for the Great Plains Region

*Prepared for:*

*Agricultural Marketing*

*Resource Center*

*Prepared by:*



**TABLE OF CONTENTS**

I. INTRODUCTION ..... 3

II. WHITE CORN SUPPLY-SIDE OVERVIEW..... 4

    A. Production Trends..... 4

    B. Price Trends and Relationships ..... 8

    C. Trade..... 9

III. THE MASA CORN MILLING INDUSTRY ..... 13

    A. Profile of Manufacturing Activity Related to Corn Masa Products ..... 17

    B. Processing Logistics ..... 21

IV. DEMAND FOR CORN MASA ..... 24

    A. Demand Drivers ..... 24

        1. General Population Trends..... 24

        2. Consumer-Driven Food Industry in North America ..... 26

            a) North American Economic Prosperity ..... 27

            b) Who is the Consumer of the North American Food Industry?..... 28

        3. Implications of Consumer Pull on North American Agriculture and Food Industry ..... 33

    B. Corn Products and Consumption ..... 37

    C. Overview of Principal Products that use Masa Corn: Tortilla Chips and Tortilla Bread..... 39

**LIST OF FIGURES**

Figure 1: Typical Commercial Corn and Tortilla Chip Processing ..... 3

Figure 2: U.S. Acreage of White Corn..... 5

Figure 3: Percentage of White Corn Acreage Under Contract ..... 6

Figure 4: White Corn Yields as a Percentage of Yellow Corn Yields ..... 7

Figure 5: U.S. Production of White Corn..... 7

Figure 6: White Corn Gross Price Premium to Yellow Corn..... 8

Figure 7: White Corn Yield-Adjusted Price Premium to Yellow Corn ..... 9

Figure 8: U.S. Exports of White Corn..... 10

Figure 9: U.S. Exports of White Corn to Mexico and Japan..... 11

Figure 10: U.S. White Corn Flour Trade With Mexico ..... 12

Figure 11: General Process Flow for Masa Corn Production..... 18

Figure 12: US Corn Chip Production, 1997..... 19

Figure 13: US Production of Corn Milled Products for Human Consumption, 1997 . 19

Figure 14: Ingredients Used in Tortilla Production in 1997 in the US..... 20

Figure 15: Ingredients Used in Tortilla Production in 1997 in the US (Percentage) . 20

Figure 16: US Export and Import of Corn Chips from Mexico ..... 21

Figure 17: Corn Chip Production by State, 1997 ..... 22

Figure 18: Production of Corn Milled Products for all Uses by State, 1997..... 22

Figure 19: Tortilla Production by State..... 23

Figure 20: US Population, 1980-2000 & Projections to 2020 ..... 25

Figure 21: US Population Growth & Demographic Change, 1980-2020 ..... 26

Figure 22: Share of Food Expenditures between At-Home and Away from Home .. 28

Figure 23: United States Projected Demographic Shifts ..... 31

Figure 24: Canada Projected Demographic Shifts ..... 31

Figure 25: US Projected Population Ethnic Structure Shifts ..... 32

Figure 26: Who is The North American Consumer? ..... 36

Figure 27: US Per Capita Consumption: Corn Flour & Meal..... 38

Figure 28: Indexation of US Per Capita Consumption of Major Flour Product  
Categories ..... 39

Figure 29: US Salted Snack Sales, 2001 (Sales and Volume) ..... 41

Figure 30: Tortilla Chips, Distribution (volume) by Outlet..... 43

**LIST OF TABLES**

Table 1: Dry Corn Milling Facilities, 2003..... 16  
Table 2: Top 10 Brands of US Tortilla/Tostada Chips (Based on Dollar Sales), 2001  
..... 42  
Table 3: US Bakery Sales..... 45

**LIST OF MAPS**

Map 1: Dry Corn Milling Facility Locations Compared to County-Level Corn  
Production and Major White Corn Growing Regions ..... 15

**EXECUTIVE SUMMARY**

The ever-changing landscape of American demographics continues to offer unique opportunities and challenges to the food and agriculture system. The consumer of the 21<sup>st</sup> century is certainly more diverse and demanding regarding their tastes and preferences for food compared to previous generations. Gone are the days of good old meat and potatoes taking center stage on our plates for most of our meals. Numerous forces such as increased incomes less time for food preparation have acted on the American consumer, altering what, where, when and how we eat. One of the significant shifts in the 80's and 90's has been the growth in the consumption of ethnic based foods. The adoption of Mexican style foods by the “general” population and the increasing US Hispanic population has been one of the central themes of the American food revolution. This report looks specifically at the growth and impact that Mexican style foods have had in the consumption and processing of masa corn products. Special demand and processing focus is given to the two primary products which utilize masa corn, i.e., tortilla bread and tortilla chips.

### Report Highlights:

- US production of white corn has increased from just below an average of 600,000 acres in the middle 90's to a level of 900,000 acres from 2001 to 2003.
- The percentage of white corn grown under contract increased from 50% in 1995, to 65% in 2001, where it has not changed in 2002 and 2003.
- The price premium for white corn relative to yellow corn peaked in 1998, at an average of \$0.45/bu. and has subsequently fallen to an average of approximately \$0.17/bu. in 2002.
- There are few barriers to entry in the production of white corn used for masa processing. The capital equipment used in the planting and harvesting of white corn is the same as yellow corn.
- White corn and corn masa flour purchases are concentrated in the hands of a few major buyers such as Frito-Lay (Pepsi) in the snack food tortilla chip sector and Gupo Maseca's Gruman Corp. and Grupo Bimbo in the tortilla bread sector.
- It should be noted that most of the growth in tortilla chip and tortilla bread consumption is predicated on the fact that yellow corn flour and wheat flour are

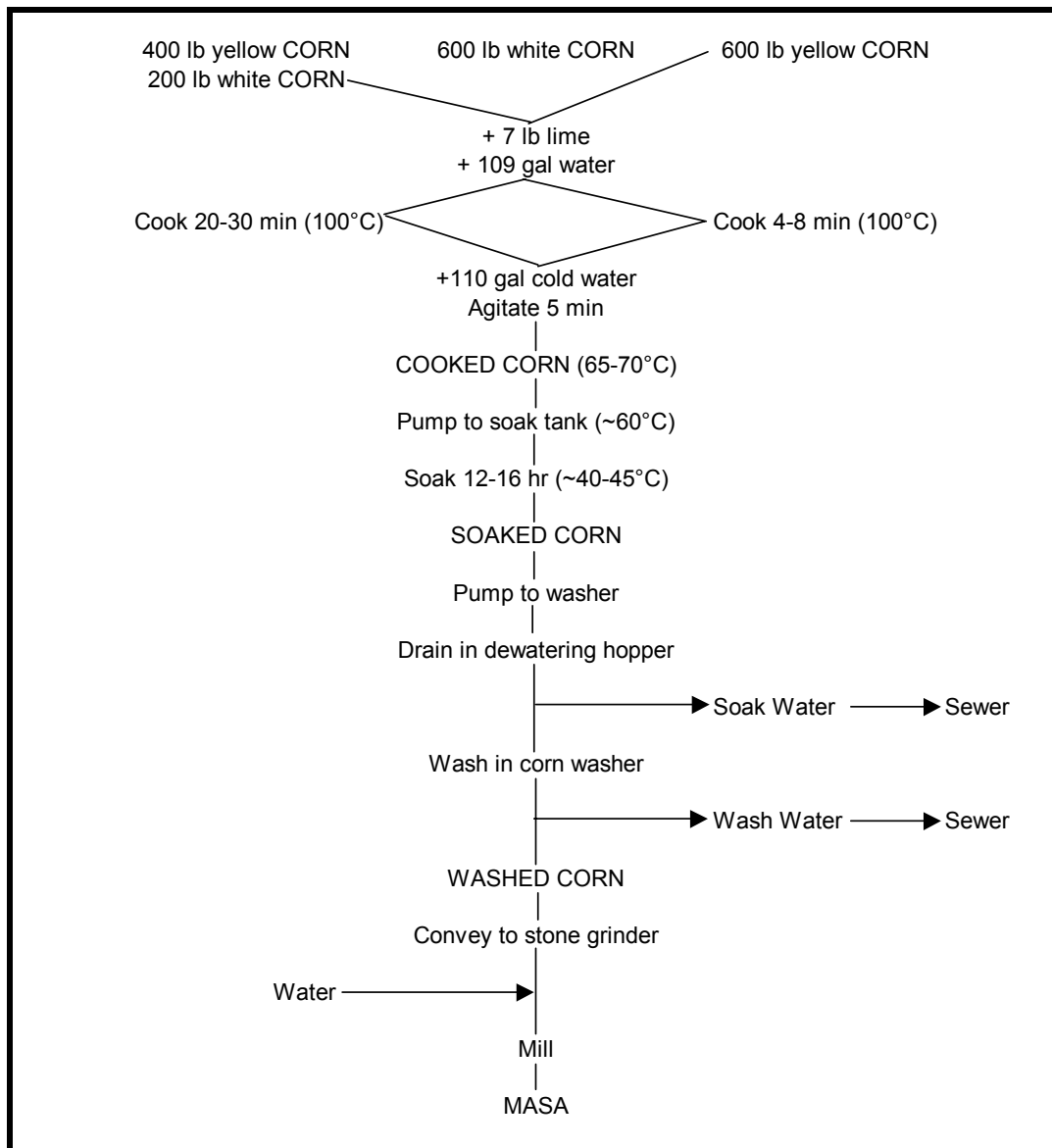
the predominate ingredients, not white corn. Most of the product volume for major food brands such as Doritos® (chips) and Gruman's Mission® (tortilla bread) utilizes either wheat flour or yellow corn. In relative terms, white corn is a small percentage of the total processed products.

- Demographics point to a continued increase in the US Hispanic population over the next twenty years because of strong rates of immigration and natural births. Growth in the Hispanic population should improve the prospectus for further consumption of masa products but in a select market niche. Total US consumption of Mexican style foods will actually begin to slow at an increasing rate. This is a function of Mexican style foods reaching a saturation level or plateau by the mainstream US consumer. Hispanics, however, are the primary consumers of masa corn tortilla bread for at home consumption (purchased via retail channels).

## I. INTRODUCTION

Corn masa is used in several Mexican foods and snack products, including table tortillas, tortilla chips, taco shells and corn chips. Masa has traditionally been produced from corn via a process referred to as nixtamalization. Corn is boiled briefly in a solution containing lime and then steeped (allowed to soak in the solution at lower temperature to loosen the pericarp). After removal from the steep liquor, the corn – now referred to as nixtamal – is washed and ground using lava or aluminum oxide stones, producing masa (see Figure 1).

Figure 1: Typical Commercial Corn and Tortilla Chip Processing



Source: Corn: Chemistry and Technology, Edited by Stanley A. Watson and Paul E. Ramstad, American Association of Cereal Chemists, 1991.

If a corn mill and a food manufacturing facility are collocated, the wet masa can be transferred directly to equipment for shaping and cooking to produce Mexican and snack foods. If the mill and the manufacturing facility are in different locations, or if the masa is to be sold at retail or used in foodservice, the wet masa can be dried for packaging, storage and transportation. Several variations on the traditional nixtamalization process have been developed for the production of dry masa flour.

During the production of masa, modifications can be made to a number of factors, such as cooking time, lime usage and especially the spacing between the grinding stones, in order to tailor the masa for specialized end-uses. In general, the stones are set closer together to produce masa with a smaller particle size for use in table tortillas, while the gap between the stones is larger for masa intended for use in taco shells and snack foods.

## **II. WHITE CORN SUPPLY-SIDE OVERVIEW**

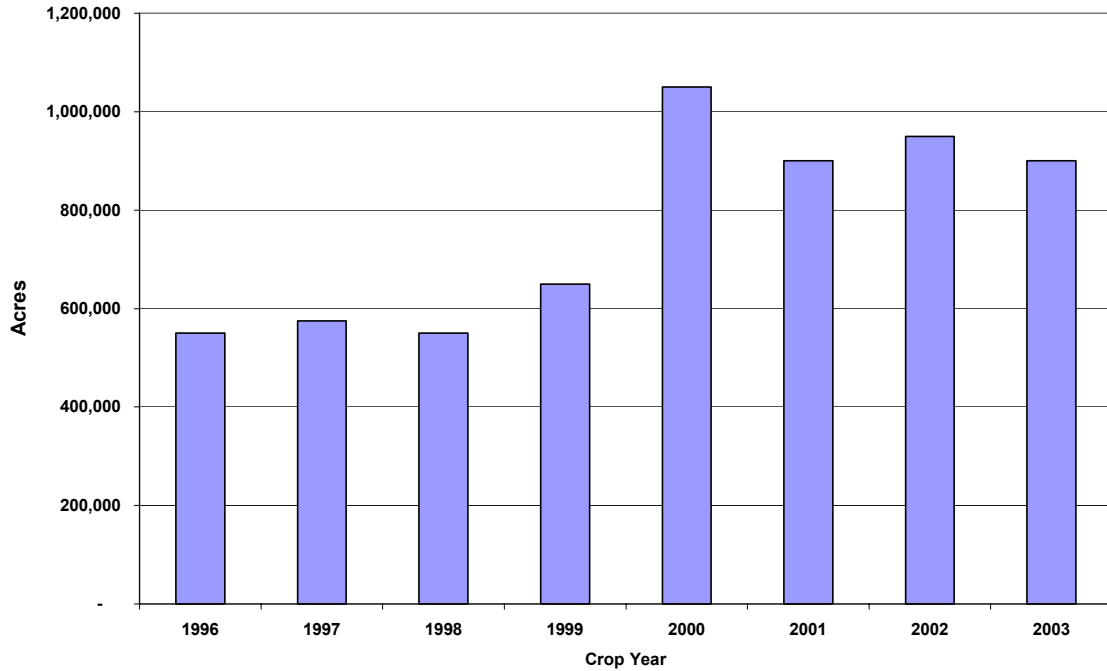
### **A. Production Trends**

While masa can be made from either white or yellow corn, traditionally white corn has accounted for at least 80% of the corn used in traditional Mexican foods. However, white corn production averages only 140 million bushels per year, accounting for only 1% of the total U.S. corn crop of 9.5 billion bushels, which predominantly consists of yellow corn. Furthermore, it is apparent that the availability of yellow corn is not a limiting factor for the expansion of food and industrial uses of corn, given the growth of the ethanol industry over the last two decades and the fact that approximately 60% of U.S. corn production is still directed toward feed and residual uses. Accordingly, since white corn is the ingredient that has limited availability for use in masa, this section focuses on the supply/demand fundamentals for white corn.

White corn acreage in the U.S. has grown significantly over the last decade as demand for white-corn-based food products has expanded. Acreage has increased from 550,000 acres in 1996 and 1998 to reach 900,000 - 950,000 acres in 2001 and 2002 (see Figure 2). In fact, due to a short South African crop and the resulting increase in U.S. exports, the area planted to white corn in the U.S. spiked to over 1 million acres in 2000, before receding slightly to recent levels.



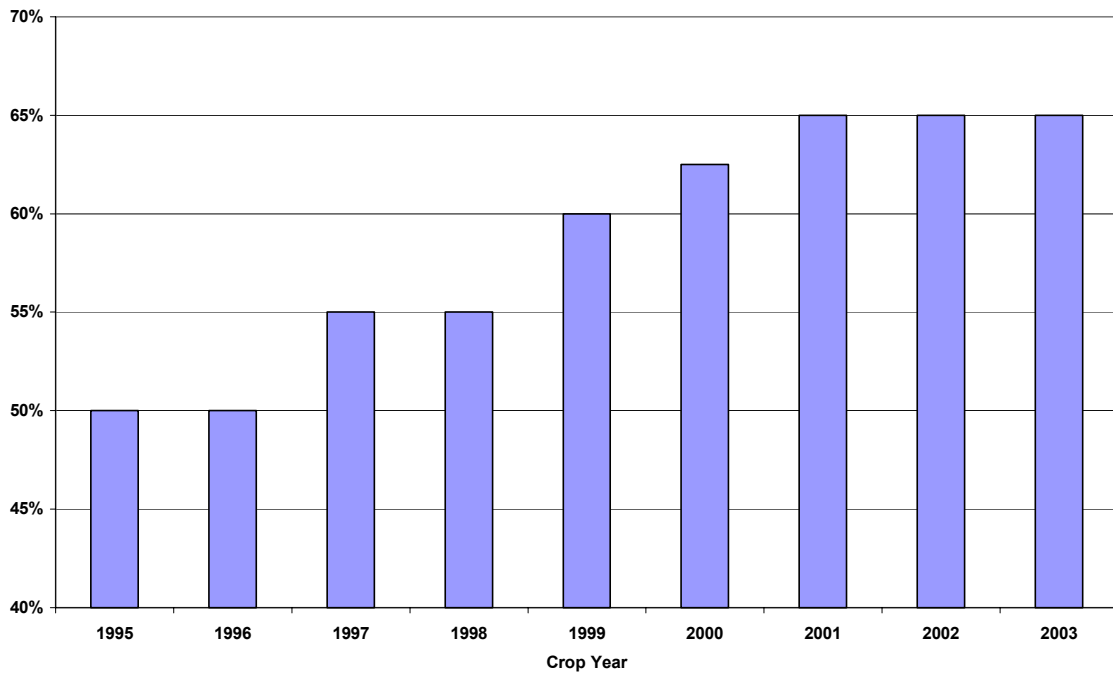
**Figure 2: U.S. Acreage of White Corn**



Source:US Grains Council, Value-Enhanced Grains Quality Reports.

The proportion of white corn that is grown under contract has increased from half of the crop in the mid-1990s to two-thirds in recent years (see Figure 3). There are low barriers to entry for a farmer to produce white corn, since the same equipment as yellow corn. The only barriers are access to a marketing channel for white corn (i.e., a local processor or merchandiser that purchases white corn) and the availability of seed.

**Figure 3: Percentage of White Corn Acreage Under Contract**

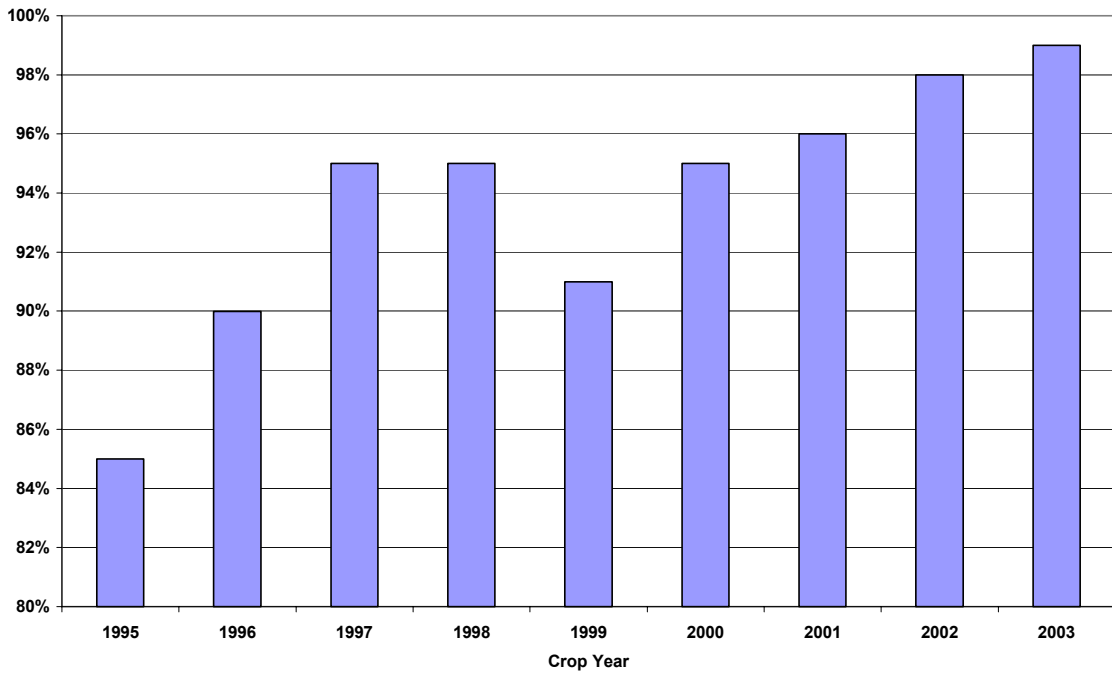


Source:US Grains Council, Value-Enhanced Grains Quality Reports.

Over the last decade, white corn yields have increased substantially faster than yellow corn yields. In 1995, an acre of white corn yielded only 85% as much as an acre of yellow corn (see Figure 4). This underperformance is referred to as “yield drag.” However, by 2002 the relative performance of white corn yields increased to 98% of yellow corn yields. If improvements to white corn varieties continue, yields should reach parity with yellow corn in the near to intermediate term.

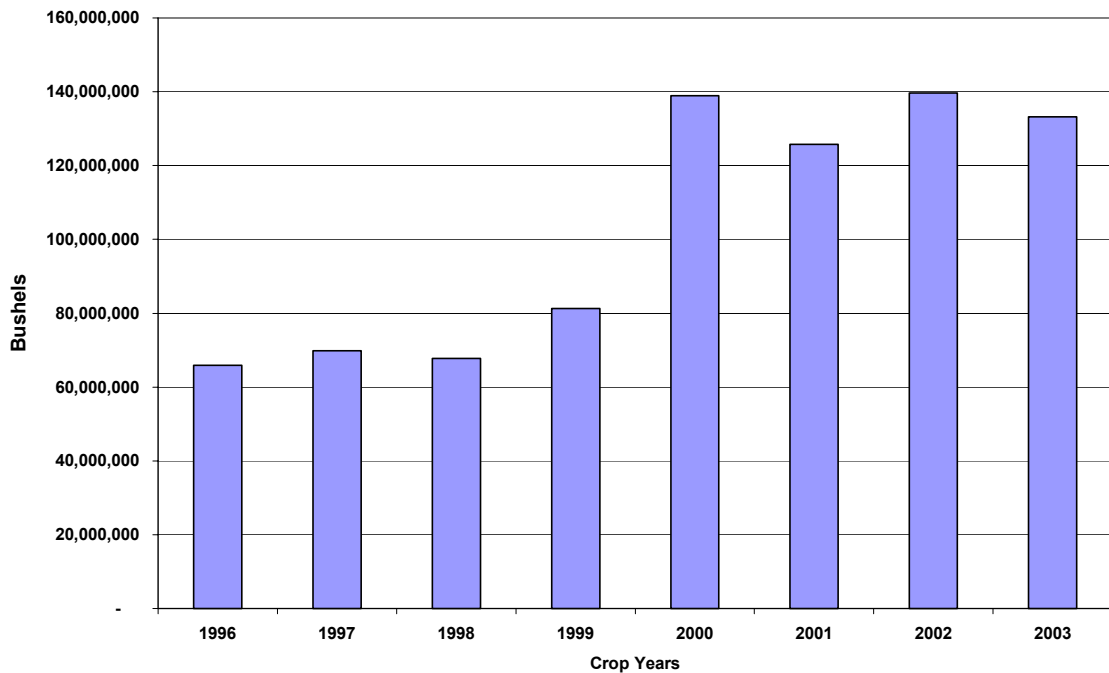
Based on a combination of higher acreage during the last few years and steadily improving yields over the last decade, the production of white corn has doubled from 66 million bushels in 1995 to almost 140 million bushels in 2002 (see Figure 5).

Figure 4: White Corn Yields as a Percentage of Yellow Corn Yields



Source:US Grains Council, Value-Enhanced Grains Quality Reports.

Figure 5: U.S. Production of White Corn

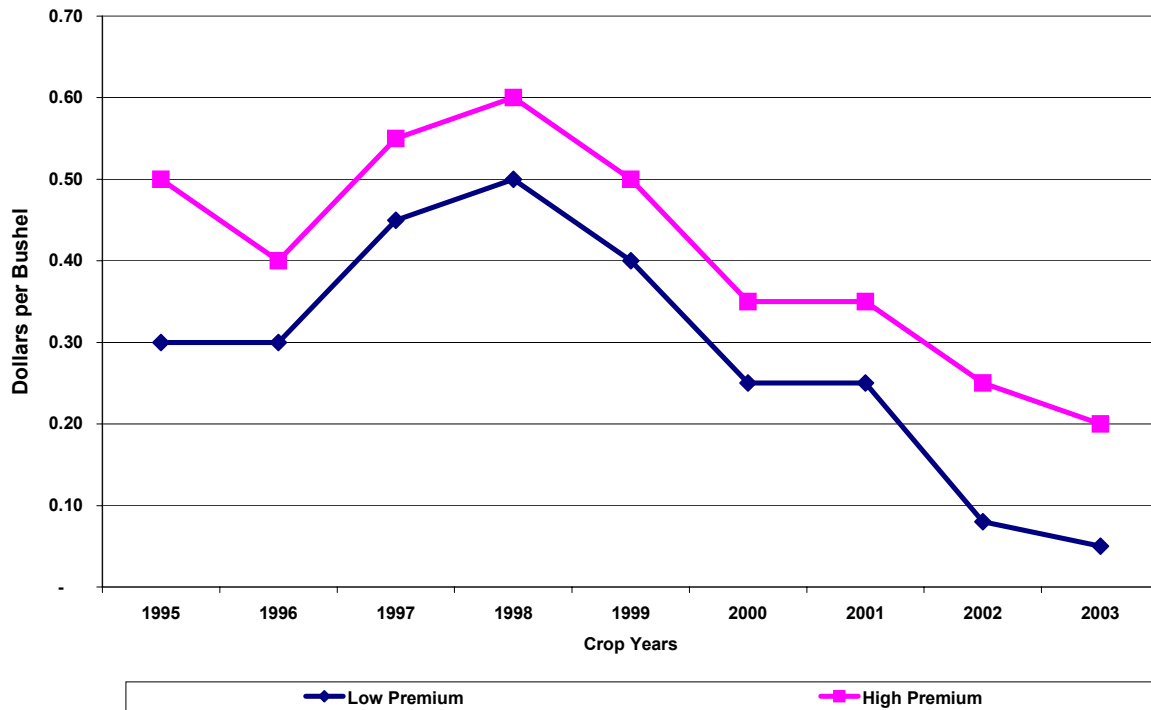


Source:US Grains Council, Value-Enhanced Grains Quality Reports.

**B. Price Trends and Relationships**

The price premium for white corn versus yellow corn rose from an average of 40¢/bu in 1995 to 55¢/bu in 1998 before falling steadily to 17¢/bu by 2002 (see Figure 6). However, expressing the premium as an absolute number of cents per bushel is somewhat misleading, since yields have been increasingly steadily over the same period, improving the effective returns offered to the farmer.

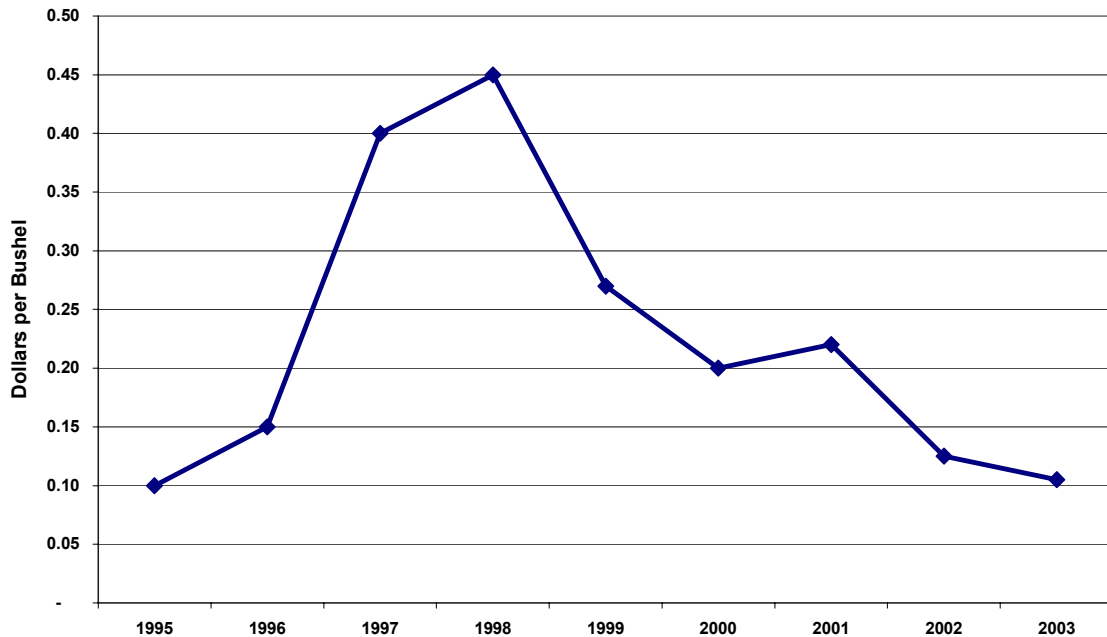
**Figure 6: White Corn Gross Price Premium to Yellow Corn**



Source:US Grains Council, Value-Enhanced Grains Quality Report.

In order to allow premiums to be accurately compared among years, it is necessary to express the premium on a yield-adjusted basis. Expressed in this manner, the premium versus yellow corn was 10¢/bu in 1995, peaked at 45¢/bu in 1998 and then fell steadily to 10¢/bu in 2002 – virtually the same level as at the start of the period (see Figure 7). Thus, it can be surmised that through the intermediate term, even if yields of white corn achieve parity with yellow corn, a premium of 10¢/bu will be necessary to entice farmers to plant white corn, follow the management and delivery requirements and take the risks associated with not meeting contractual obligations.

**Figure 7: White Corn Yield-Adjusted Price Premium to Yellow Corn**



Source:US Grains Council, Value-Enhanced Grains Quality Reports and Sparks.

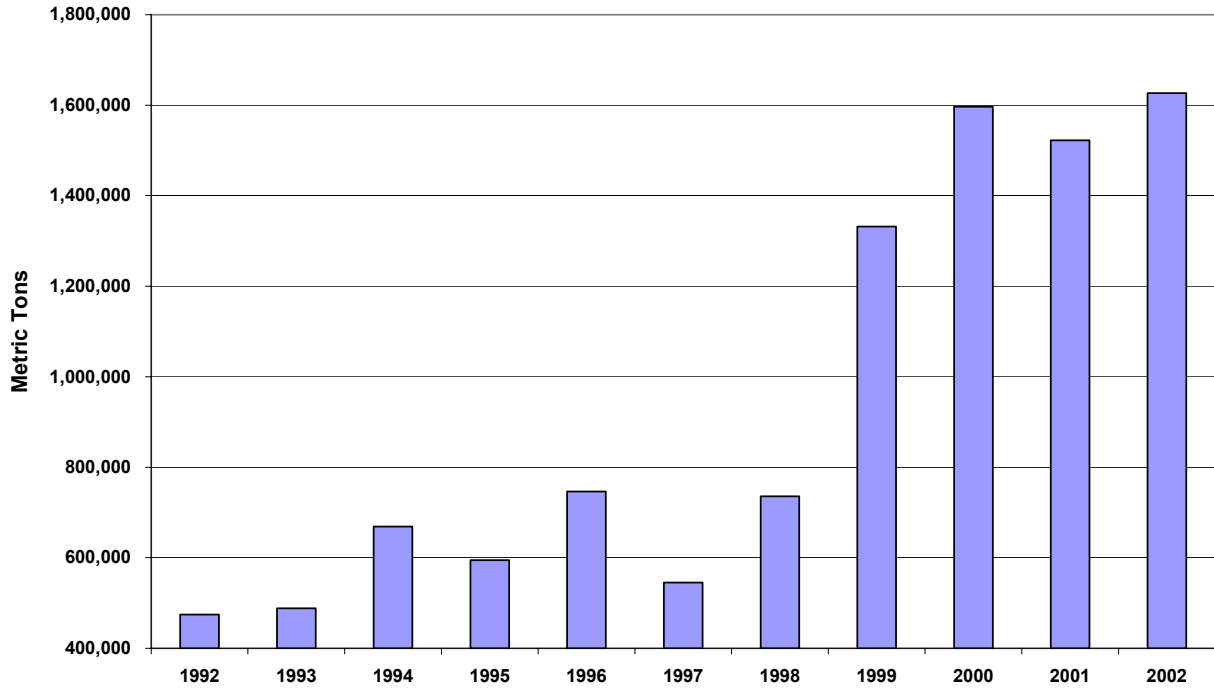
### **C. Trade**

Exports of white corn have increased dramatically over the last decade, from roughly 600,000 tons to over 1.6 million tons (see Figure 8). A large share of the increase is attributable to a jump in trade with Mexico that occurred as trade barriers were lowered under the terms of the North American Free Trade Agreement (see Figure 9). Mexico now is by far the largest market for U.S.-produced white corn. Japan is also a significant, but much smaller, destination.

As of the writing of this report, questions exist as to whether Mexico will attempt to "reopen" the North American Free Trade Agreement (NAFTA) provisions regarding access to its dried bean and white corn markets. Mexico reportedly may ask the U.S. and Canada to accept permanent controls on access to these markets under an emergency plan "to save the impoverished Mexican countryside." While the current Mexican administration has apparently decided against calling for changes to NAFTA's agriculture chapters, Mexican officials have been willing to seek side agreements to alter tariff phase-out schedules. Furthermore, Mexican officials have

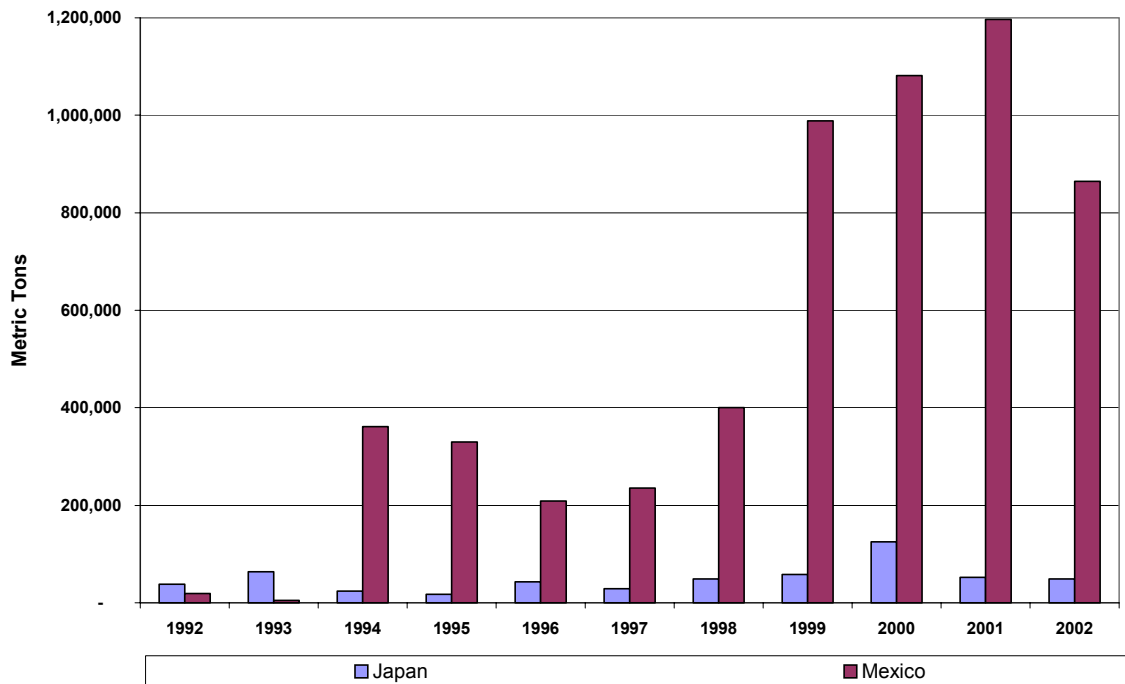
stated that if there is a surge in demand for either product, strict safeguards accompanied by high tariffs rate quotas should be used to regulate imports.

**Figure 8: U.S. Exports of White Corn**



Source:USDA, FAS.

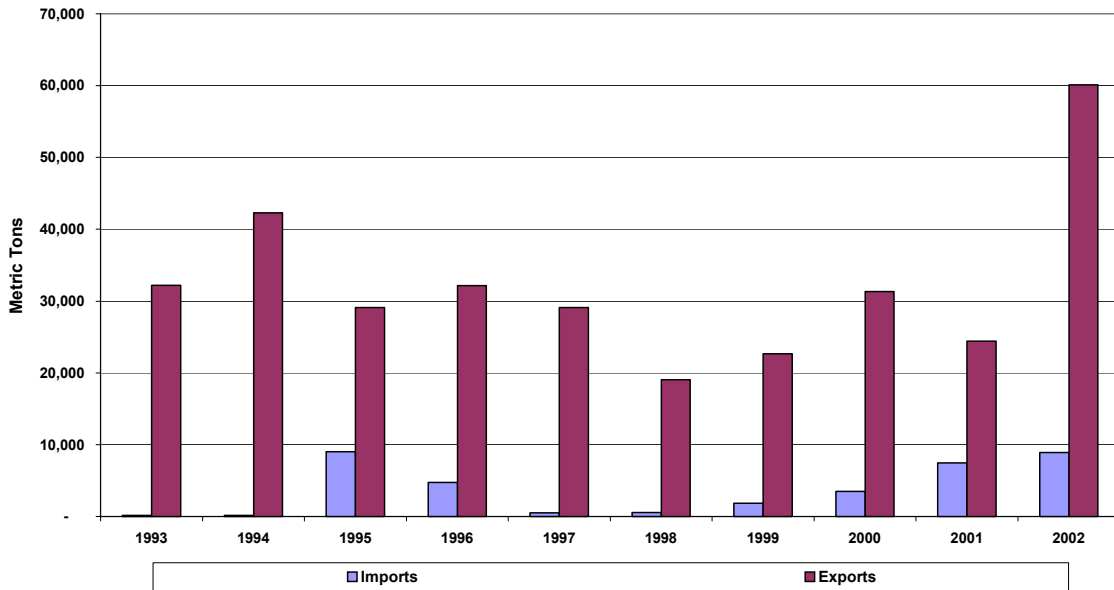
Figure 9: U.S. Exports of White Corn to Mexico and Japan



Source:USDA, FAS.

As this increase in white corn exports to Mexico has occurred, shipments of white corn flour to Mexico have generally stayed in a range of 20,000 – 40,000 metric tons (see Figure 10). However, in 2002 the composition of shipments shifted, with substantially more product volume being shipped as flour versus grain. This increase in flour exports was a function of reduced real price incentive for Mexican farmers to plant corn and lower yields because of poor weather (thus leading to lower corn production in 2002). The growth in US shipments of white corn, and more recently flour, have been occurring at the same time that imports of finished food products into the US have been from Mexico.

**Figure 10: U.S. White Corn Flour Trade With Mexico**



Source:USDA, FAS.



### **III. THE MASA CORN MILLING INDUSTRY**

White corn production tends to occur in several distinct regions in the U.S. Some white corn production occurs in the region generally recognized as the Corn Belt, including an area stretching from central Illinois through central Indiana and down to northern Kentucky, as well as the border region where the states of Iowa, Nebraska, Kansas and Missouri meet (see Map 1). White corn acreage is also located in several areas that are less productive but advantageous from the standpoint of local processing facilities, local consumption of white corn products and/or trade with Mexico. These areas include the Texas Panhandle, southern Texas and central California.

Both white corn and yellow corn can be used in the production of masa. Often, white corn comprises most of the material in a masa product, with yellow corn added for color and texture. Some food processors are even blending organic blue corn flour into tortilla chips for a designer look and flavor.

Bunge Milling (formerly Lauhoff) and Cargill's Illinois Cereal Mills division are the largest dry millers of corn in the U.S., each having a grinding capacity of 86,000 bushels per day (see Table 1). Gruma Corporation's Azteca Milling subsidiary is a close third, with capacity of 81,000 bushels per day. The second tier of dry millers (from the standpoint of capacity) includes J. R. Short Milling, Quaker Oats, ConAgra, Archer Daniels Midland, Lakeside Mills and American Milling.

The publication *Snack Foods and Wholesale Bakery (SFWB)* reports that the industry is dominated by three corporate giants.

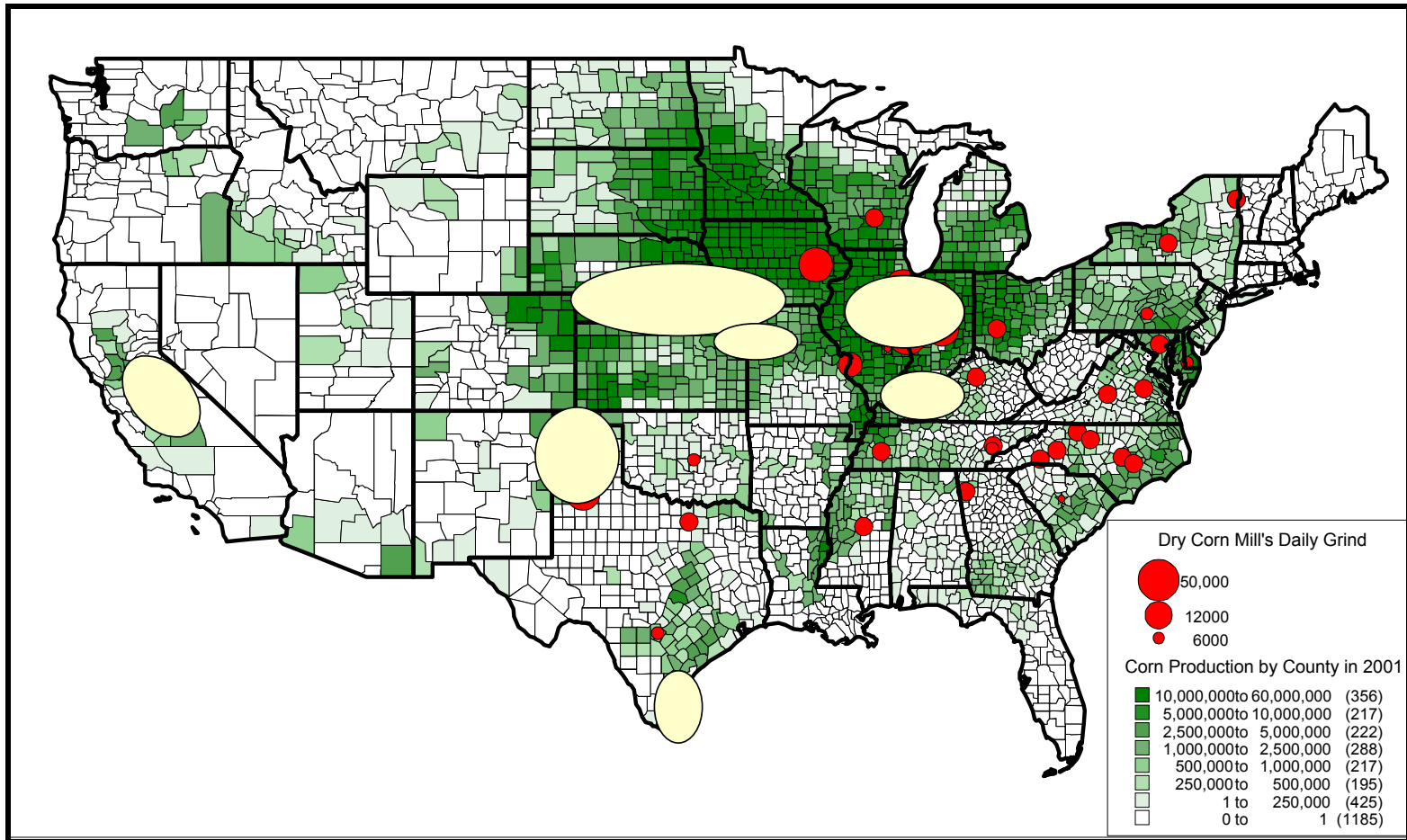
- Grupo Maseca's Gruman Corp. (13 tortilla plants in the US) with tortillas sold under the brands of Mission, Calidad, La Predilecta and Guerrero. Restaurant sales include KFC and Subway to make wraps. SFWB estimates that Mission has a total market share of 40% of all Tortilla sales. Mission thinks the share is closer to 54% of the retail market. Mission's current strategy is to begin consolidating their different brands into one dominant brand with a few "flanker" regional brands.
- The second largest processor is Grupo Bimbo, with sales of tortillas under the names of Tia Rosa and Mrs. Baird's (they bought Mrs. Baird's Bakeries in 1998).

## ***The U.S. Corn Masa Industry***

---

- The third largest player is Tyson Foods. Their sales are limited in retail channels, but they are significant in wholesale channels with special focus on restaurants and the food-service industry.
- The big three dominate the tortilla bread industry however; there are many start-ups that are flying well below the radar screen.

**Map 1: Dry Corn Milling Facility Locations Compared to County-Level Corn Production and Major White Corn Growing Regions**



*Note: White corn growing regions are indicated as yellow ovals.*

*Source for white corn production locations: U.S. Grains Council Value-Enhanced Grains Report, 2003.*

*Corn Production Data: USDA, NASS, County Estimates, 2001.*

**Table 1: Dry Corn Milling Facilities, 2003**

<b>Company</b>	<b>City</b>	<b>State</b>	<b>Daily Grind (Bu.)</b>
ADM Milling Co.	Lincoln	NE	13,000
ADM Milling Co.	Jackson	TN	12,000
Agricore, Inc.	Marion	IN	12,000
Allen Brothers Milling Co.	Columbia	SC	2,000
American Milling Co.	Cahokia	IL	20,000
Amherst Milling Co., Inc.	Amherst	VA	12,000
Arrowhead Mills, Inc.	Hereford	TX	12,000
Ashland Milling Co.	Ashland	VA	12,000
Azteca Milling (Gruma Corp)	Madera	CA	8,000
Azteca Milling (Gruma Corp)	Evansville	IN	22,500
Azteca Milling (Gruma Corp)	Henderson	KY	4,500
Azteca Milling (Gruma Corp)	Amarillo	TX	30,000
Azteca Milling (Gruma Corp)	Edinburg	TX	18,000
Azteca Milling (Gruma Corp)	Plainview	TX	34,000
Bunge Milling	Danville	IL	50,000
Bunge Milling	Crete	NE	36,000
Cargill Illinois Cereal Mills Div.	Paris	IL	50,000
Cargill Illinois Cereal Mills Div.	Indianapolis	IN	36,000
Cereal Food Processors, Inc.	Bonner Springs	KS	12,000
Champlain Valley Milling Corp.	Westport	NY	12,000
Clifton Mill Co.	Clifton	OH	12,000
Clover Hill Milling Co	Maryville	TN	6,000
ConAgra Corn Processing	Atchison	KS	36,000
Crescent Mills (Hopkinsville Milling)	Hopkinsville	KY	6,000
Didion Milling, Inc.	Cambria	WI	12,000
H. R. Wentzel Sons, Inc.	Landisburg	PA	6,000
Hodgson Mill, Inc.	Effingham	IL	2,000
Hopkinsville Milling Co.	Hopkinsville	KY	12,000
House-Autry Mills, Inc.	Four Oaks	NC	12,000
J. R. Short Milling Co.	Kankakee	IL	50,000
King Milling Co.	King	NC	12,000
Lakeside Mills, Inc.	Rutherfordton	NC	12,000
Lakeside Mills, Inc.	Seven Springs	NC	12,000
Midstate Mills, Inc.	Newton	NC	12,000
Morrison Milling Co.	Denton	TX	12,000
New Hope Mills	Moravia	NY	12,000

## The U.S. Corn Masa Industry

---

North State Milling Co. Inc.	Greensboro	NC	12,000
Nunn Milling Co., Inc.	Evansville	IN	12,000
Pioneer Flour Mills	San Antonio	TX	6,000
Quaker Oats Co.	Cedar Rapids	IA	36,000
Quaker Oats Co.	St. Joseph	MO	12,000
Scott's Auburn Mills, Inc.	Auburn	KY	6,000
Shawnee Milling Co.	Shawnee	OK	6,000
Southeastern Mills, Inc.	Rome	GA	12,000
The Attala Co.	Kosciusko	MS	12,000
UNOI Grain Mill	Seaford	DE	6,000
Weisenberger Mills, Inc.	Midway	KY	12,000
White Lily Foods Co.	Knoxville	TN	12,000
Wilkins-Rogers, Inc.	Ellicott City	MD	12,000
Wilson's Corn Products, Inc.	Rochester	IN	12,000

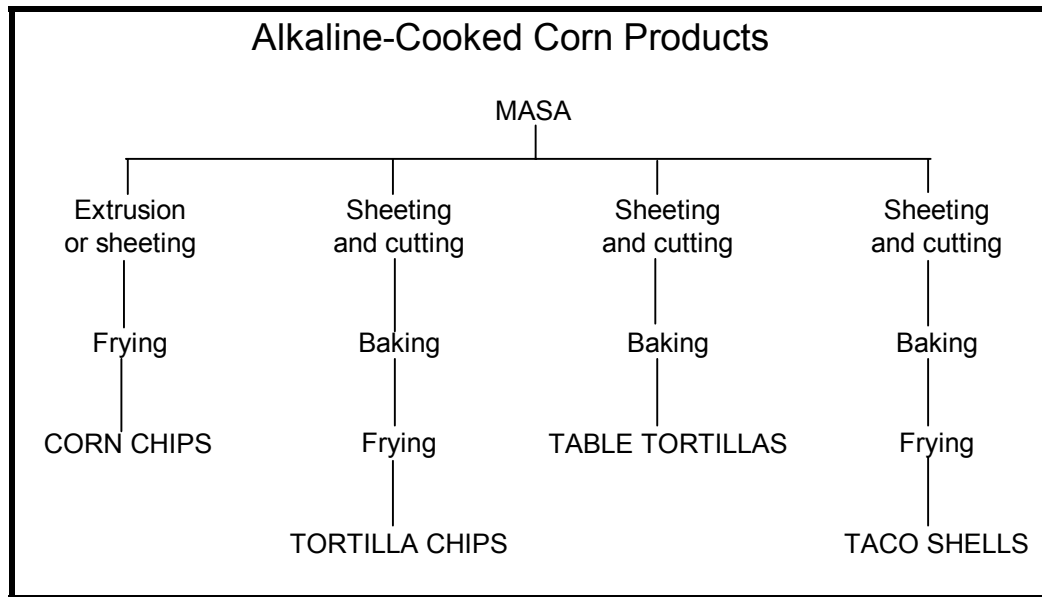
Source: Milling and Baking Annual 2002, and Sparks Estimates.

### A. Profile of Manufacturing Activity Related to Corn Masa Products

The most recent comprehensive review of food manufacturing activity in the US was the **1997, US Census of Manufacturing**. The **2002, Census of Manufacturing** is not scheduled for release until the fourth quarter of 2004. This section and the following section review some of the statistical highlights regarding US manufacturing activities related to corn processing. Unfortunately, specific details concerning corn masa processing are not included in the Census survey however; food products are identified in which corn masa is generally used.

The predominant use of masa in processed foods is in the food categories of Mexican style and snack. Within the primary categories, such products as table tortillas, tortilla chips, taco shells and corn chips are identified. Figure 11, illustrates the general flow of masa in the manufacturing process.

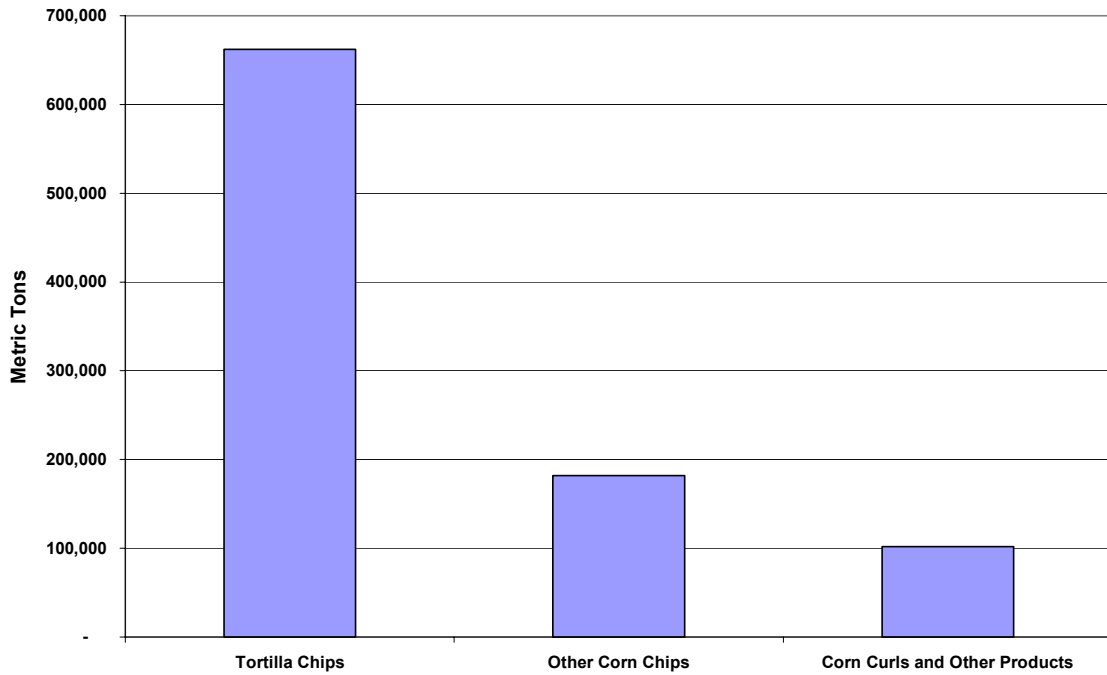
**Figure 11: General Process Flow for Masa Corn Production**



Source: Corn: Chemistry and Technology, Edited by Stanley A. Watson and Paul E. Ramstad, American Association of Cereal Chemists, 1991.

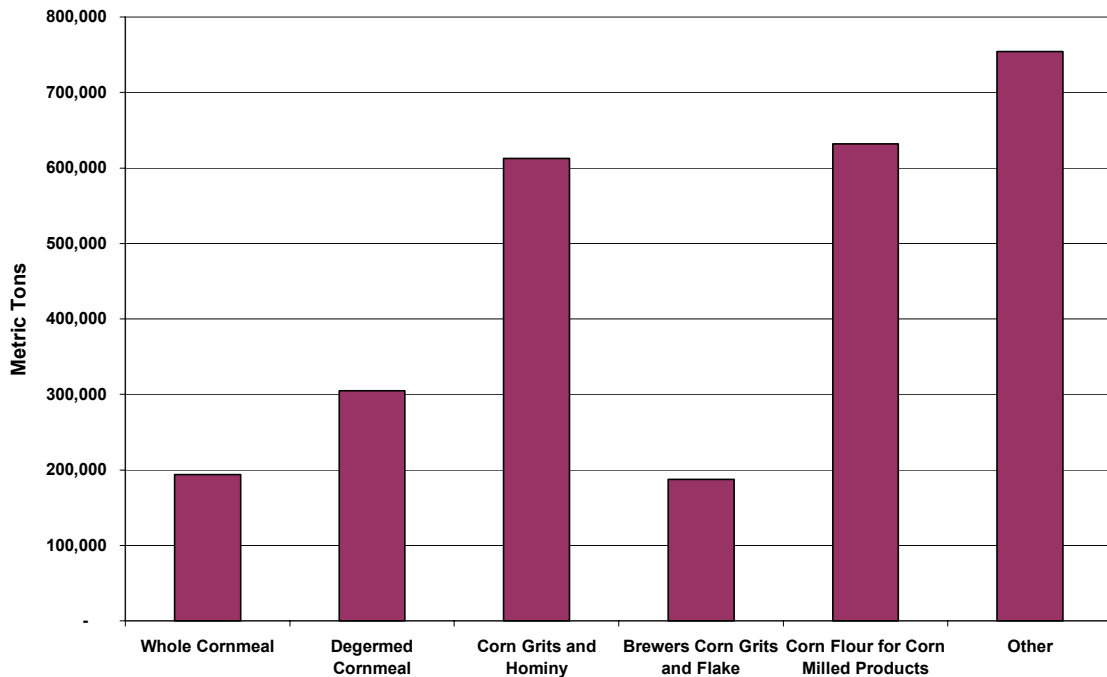
The tortilla chip production is about 40% greater than the amount of corn used in tortilla production. In addition, the amount of corn flour used for corn milled products is about the same size as tortilla chip production. Not surprisingly, tortilla chips are the driving force behind corn tortilla production.

Figure 12: US Corn Chip Production, 1997



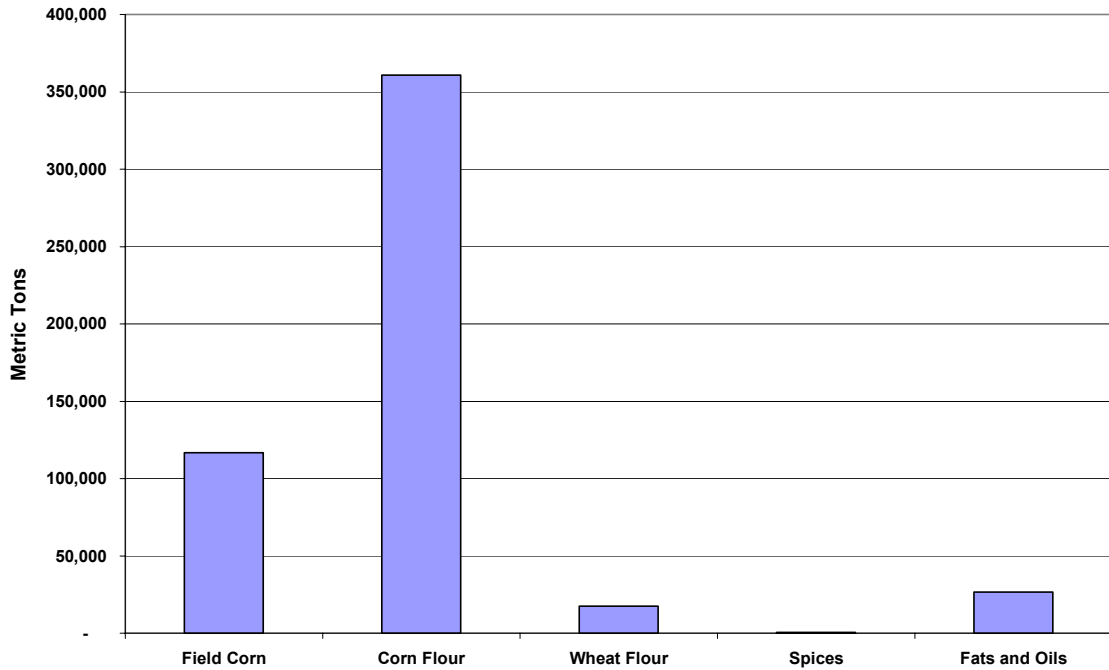
Source: Corn: US Department of Commerce, Census of Manufacturing, 1997.

Figure 13: US Production of Corn Milled Products for Human Consumption, 1997



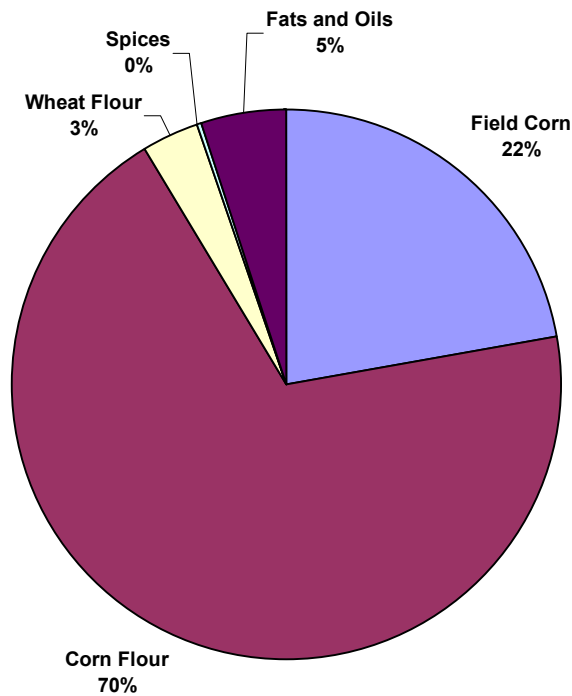
Source: Corn: US Department of Commerce, Census of Manufacturing, 1997.

Figure 14: Ingredients Used in Tortilla Production in 1997 in the US



Source: Corn: US Department of Commerce, Census of Manufacturing, 1997.

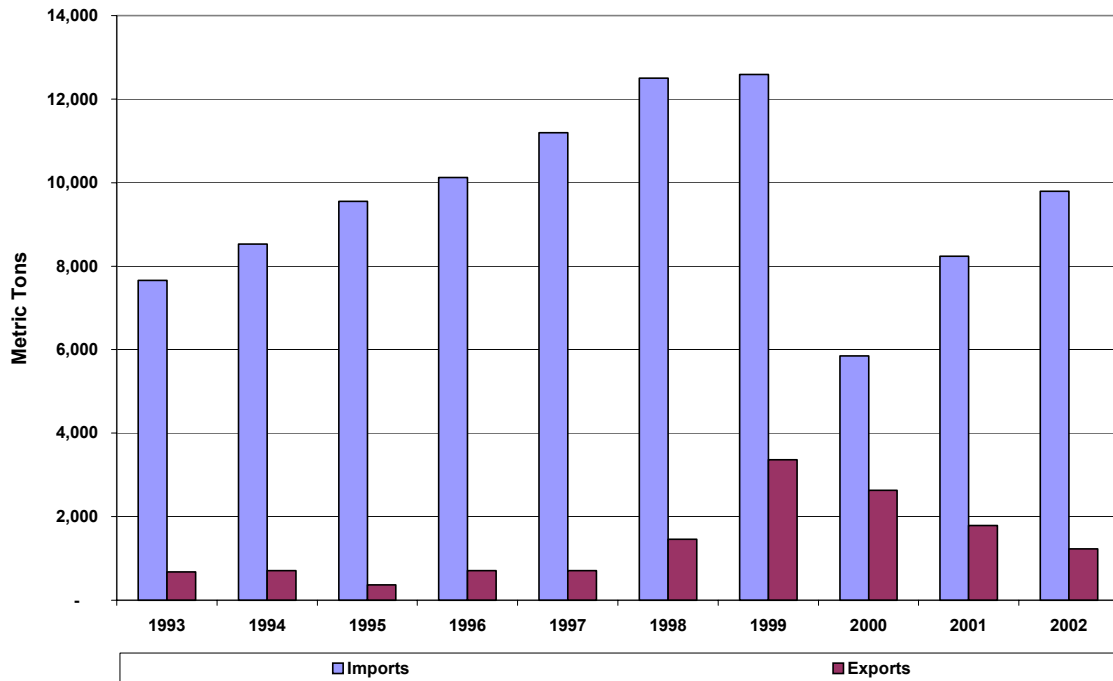
Figure 15: Ingredients Used in Tortilla Production in 1997 in the US (Percentage)



Source: Corn: US Department of Commerce, Census of Manufacturing, 1997.



**Figure 16: US Export and Import of Corn Chips from Mexico**



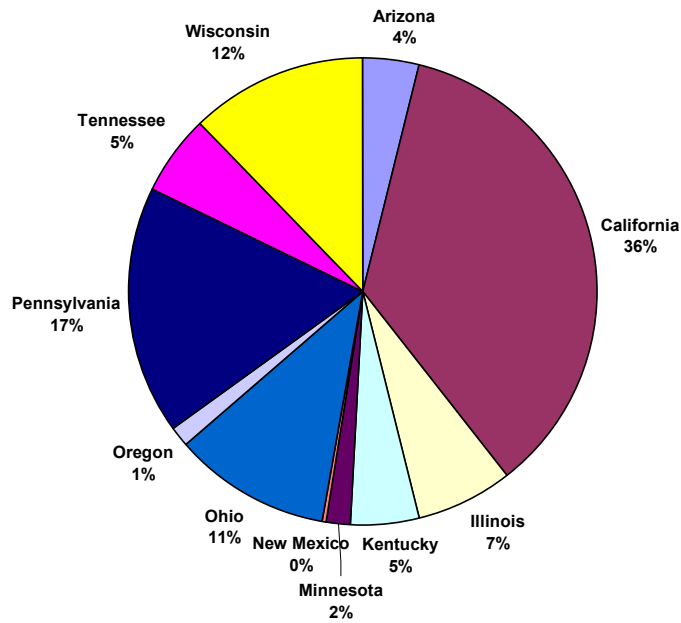
Source: Corn: US Department of Commerce, Census of Manufacturing.

### **B. Processing Logistics**

The production of tortilla chips is located near population centers while the production of corn flour is located near corn production centers. It is less expensive to transport corn flour than corn or finished products. This is due to the density of the products involved. Over 50% of tortilla production is located in California while tortilla chip production is more diversified. This reflects a greater demand for tortilla chips among the general population.

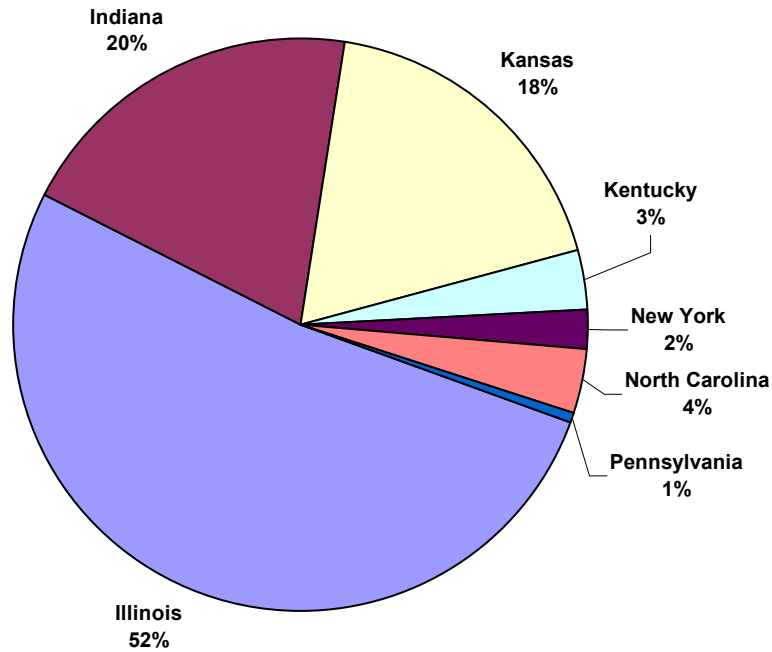
From a regional demand perspective, according to a Snack Food Association Report (SFA), the Pacific states lead the country in tortilla and snack production, with 22% of tortilla plants and 16% of snack-food plants located in this region. Next were the mid-Atlantic states and the west south central states (Arkansas, Louisiana, Oklahoma, Texas). The west central states are the largest overall snack consumers at 24 lbs. per person, as compared to the national average of 21 lbs. per person. At 6 lbs. per year, the southwest states consume the most tortilla chips, as compared to the overall average of 4 lbs. per year.

Figure 17: Corn Chip Production by State, 1997



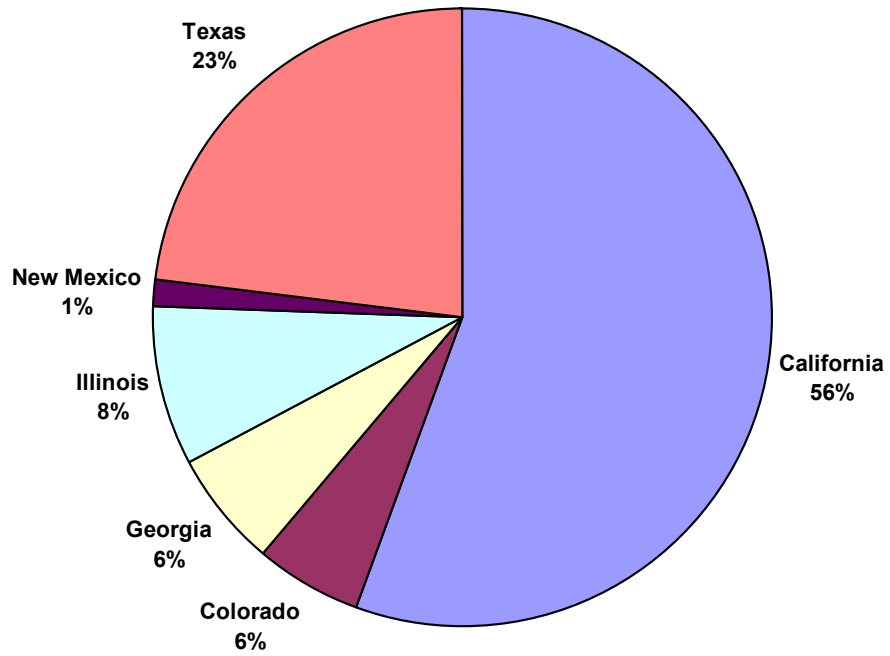
Source: Corn: US Department of Commerce, Census of Manufacturing, 1997.

Figure 18: Production of Corn Milled Products for all Uses by State, 1997



Source: Corn: US Department of Commerce, Census of Manufacturing, 1997.

**Figure 19: Tortilla Production by State**



Source: Corn: US Department of Commerce, Census of Manufacturing, 1997.

## **IV. DEMAND FOR CORN MASA**

### **A. Demand Drivers**

#### **1. General Population Trends**

The logical starting point for any discussion of food demand is the population makeup of the domestic economy. For the corn masa industry in the US it is not, so much the numbers of people in the population as it is what are the demographic changes that are impacting demand. The bullet points below highlight some of the population dynamics at work in the US. This section is followed by general examination of consumer trends that might impact the corn masa industry and then by a more detailed look at the end use markets for corn masa products. General population trends:

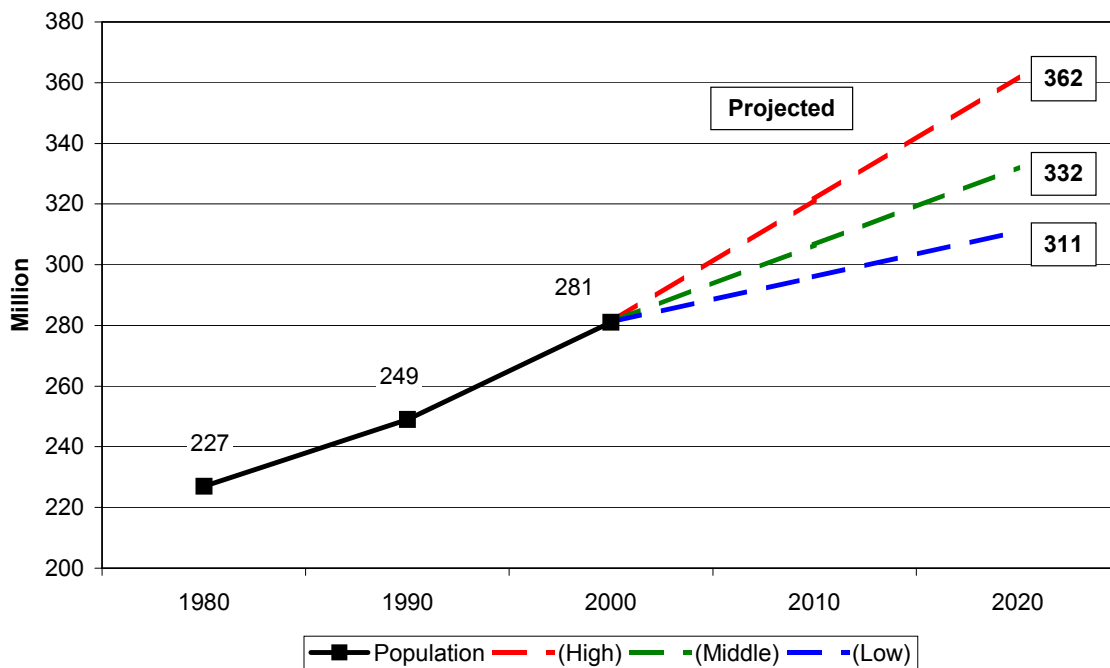
- Based on the 2000 Census, approximately 281 million Americans were counted. This was an increase of 54 million people from 1980, up 23.8%. This steady rise in Americans from 1980 to 2000 is displayed in Figure 20.
- By 2020, the Census Bureau projects between 50 to 80 million people will be added to the year 2000, base of 281, bringing the total population to between 331 (low forecast) million to 362 (high forecast) million people. While this appears to be a significant increase in population, an addition of 65 million people, it represents only a 1.28% compounded growth rate over the 20 year period. Food producers will need to rely on more than simple population growth to increase sales volume by more than 1% to 2% per year.
- Interestingly, most of the population growth is expected to come from immigration. The repercussions of the continued influx of new faces from abroad will be significant regarding US demographics by the year 2020.
- The Hispanic segment of the US population will be the fastest growing, (see Figure 21, for a breakdown of ethnic population change). Hispanics are projected to add 1.2 million more people annually over the next twenty years. This compares to a population growth of only 500,000 annually for Whites, and 400,000 for Blacks and Asians.

## The U.S. Corn Masa Industry

---

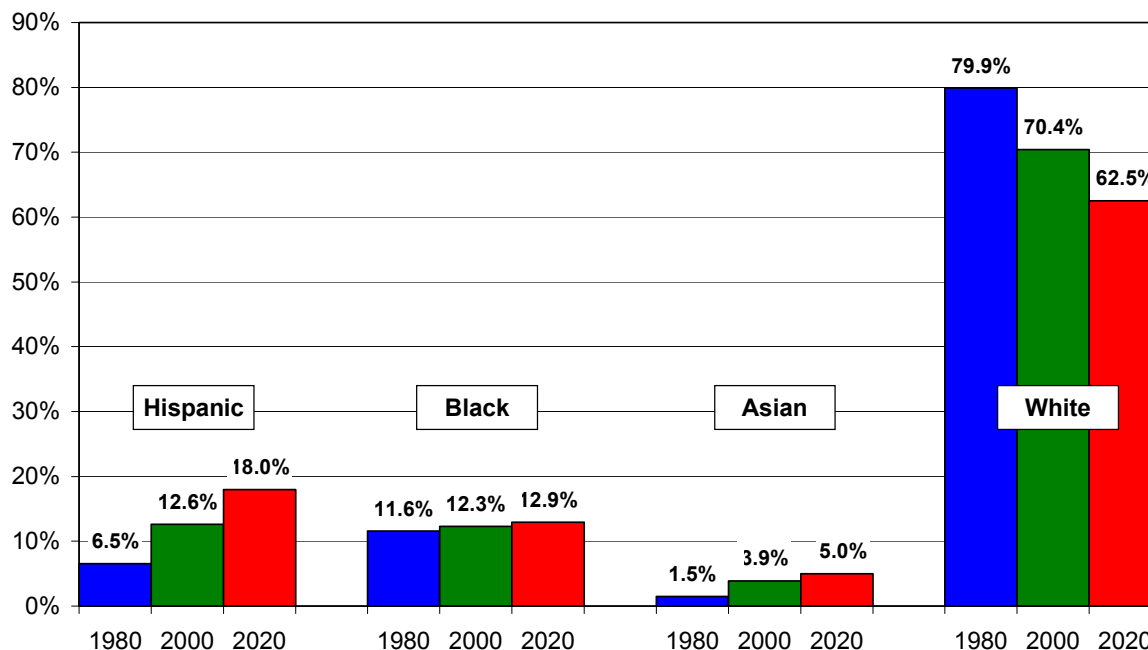
- The growth in the Hispanic and Asian segments is anticipated to come from the combination of both immigration and new births. The predominant growth for Blacks and Whites, however, is projected to be from natural increases (births minus deaths).
- If these projections come to fruition, the shift in US demographics will cause a shift towards a younger age structure for minorities who will have built-in growth momentum as a high proportion of that population will be in the childbearing years. For example, the current median age of non-Hispanic Whites is 38.1, versus only 26.5 for Hispanics.

**Figure 20: US Population, 1980-2000 & Projections to 2020**



Source: US Census Bureau, USDA, ERS.

**Figure 21: US Population Growth & Demographic Change, 1980-2020**



Source: US Census Bureau, USDA, ERS.

## **2. Consumer-Driven Food Industry in North America**

Over the last decade, positive economic growth and a shifting demographic structure in North American markets have accelerated the transition of the food industry from a supply-push system to a demand-consumer pull system. The current level of this transition and the speed at which it changes is greater on the upper level of the value chain (closer to the end-consumer).

The major driving forces of the North American consumer-driven food industry include: (a) economic prosperity, (b) shifting demographic structure (aging population, cultural diversification, changing lifestyles, women in the workplace), and (c) better access to information. The corn masa industry is part of this environment and the following factors will need to be considered when thinking about future growth of the segment. Moreover, in order to make intelligent investment decisions within the context of the corn masa industry, it is necessary to understand the dynamics of the US food system within the context of global demand for food.

Consumer-driven demand or “consumer-pull” is not an entirely new trend. Consumer-pull, however, is expected to be among the most significant drivers of

food consumption in the future and thus create opportunities for firms that adopt strategies accordingly. It is important to note that consumer-pull is a global trend with greater pressure across developed and mature food markets such as Canada, the US, EU or Japan. In order to assess the future implications of a consumer-driven system, it is necessary to examine the genesis and outlook of its driving forces. By anticipating the impacts of consumer-pull, one can anticipate opportunities. Firms that seize the opportunities will enjoy a greater share of the domestic and international market, while those that do not will be left to compete in the mature and highly competitive North American market.

### a) North American Economic Prosperity

As per-capita earnings in the US have expanded over the past decade, new trends and shifts in consumer buying patterns began to emerge as time management and convenience became more important in food purchasing decisions. North American consumers are shifting from a value concept of “pay vs. get” (volume) to a concept of “pay vs. time and quality” (volume vs. time and quality). In the more developed and wealthier economies such as the US and Canada, consumers are generally “money rich” but “time poor,” thus the need for food products that they can use to adjust to the new lifestyles.

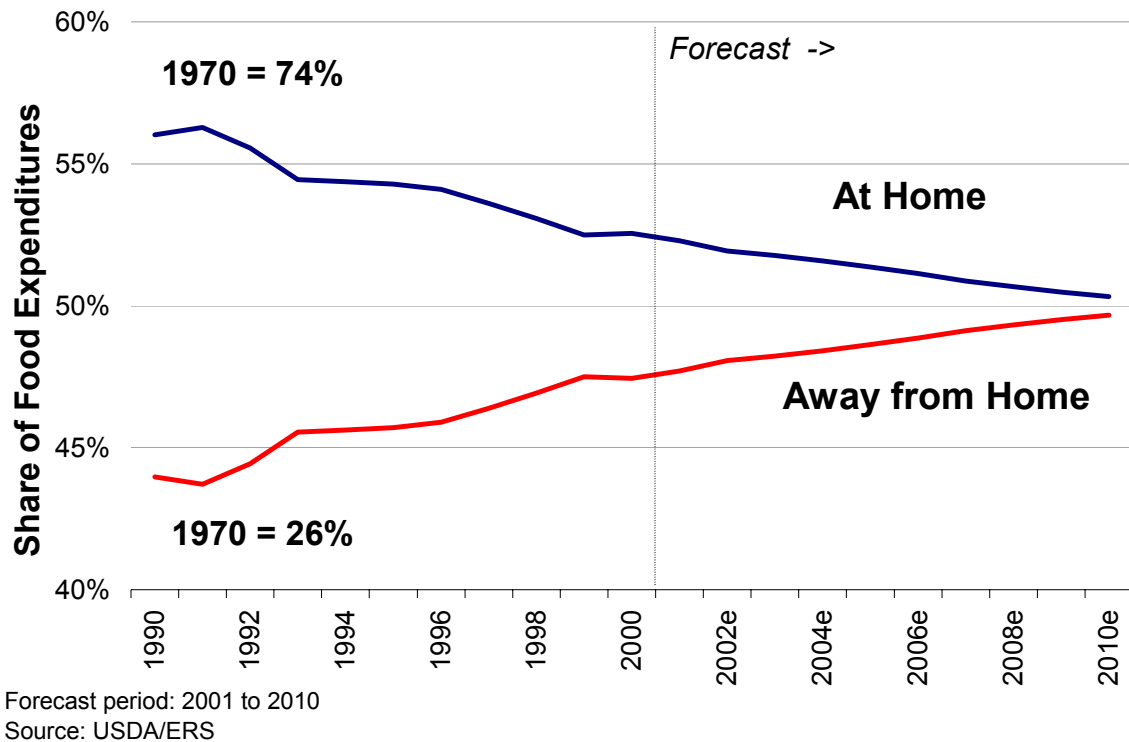
- Consumers with less time and more money sought increased eating experiences that were away from home, demanding foods that were more ethnically diverse, safer and often healthier than in years past. In 2000, consumers spent approximately 47.5% of their food budget for away-from-home eating experiences, compared to only 26.1% in 1970. This trend should continue through 2010 with away from home food expenditures reaching 49% by 2010, see Figure 22.
- The North American food processors, including corn millers will see similar trends as consumers further demand new products from the sector. Product innovation beyond the basic offerings will be necessary to fuel future growth.

Food manufacturers and retailers should be prepared to continue the battle against the well-entrenched trend of a shrinking percentage of food eaten at home. The amount of food eaten at home will likely decline as food eaten away from home (including home meal replacement HMR's) sharply increases. Warehouse clubs

## The U.S. Corn Masa Industry

such as Costco's and Sam's have moved aggressively to include and expand their offerings of fresh and high quality HMR's that can be easily heated (if needed) and served at home. The masa corn industry will be challenged to find new and creative opportunities in the food service sector in order to maintain "overall" strong sales growth as at home consumption of food lessens.

**Figure 22: Share of Food Expenditures between At-Home and Away from Home**



- The rise of affluence in the US is captured in the data showing that the share of food expenditures as a percent of disposable income has declined significantly from 13.8% in 1970, to only 10.7% in 1997. This has allowed consumers to "trade-up" to higher value and value-added products in their diets.

### b) Who is the Consumer of the North American Food Industry?

The main consumer of North American agricultural and processed food products is the domestic market (Canada and US); however, to a varying degree the international market is also a consumer. Depending on the product (commodity or



value-added) and importing country (developed or developing), the consumer will have different characteristics and needs.

Structural demographic changes are shifting the overall composition of the North American consumer. The various segments of the population are changing at different rates, and thus tilting the mix of food products "pulled" by consumers. Key demographic changes are (1) an aging population, (2) increased ethnic diversity, (3) changing lifestyles (such as increased number of women in the workforce) and (4) demographic bubbles (large number of baby boomers and their kids).

### *(1) An Aging North American Population*

- Figure 23 shows the projected demographic shifts by age category. The figures illustrate the movement of the baby boomers (45-55) and their impact on the structure of US population.
- For both Canada and the US, the segment of 45 and over captures over 90% of the segment-growth from 2000-2010.
- As the boomers age, marketers are finding that the older consumers are the bigger spenders - and always were. As "youth" was the target while boomers were in that range, marketers will find that the older age groups are prime targets now.
- Older households, with their higher incomes, are spending more, while spending of younger households is decreasing.
- On a per capita basis, those in the 45-54 age group spend 17% more than an average household, and those in the 55-64 group spend 15% more. Even households in the 65-74 age group spend the "average" amount, specifically spending a higher amount in restaurants than those aged 25-34.<sup>1</sup>
- North America is not alone in the growth in geriatrics, older populations in the developed world are increasing. This trend is beginning to put pressure on higher health care costs and is behind the interest in using foods as nutritional carriers for improved human health, largely as a function of prevention.

---

<sup>1</sup> The Bureau of Labor Statistics' 1995 Consumer Expenditure Study.

- The impact of an aging population on the corn masa industry at this point is a question mark. Will corn masa products be able to fit into an older populations need for convenience, taste and nutritional value?

### *(2) Growth in Cultural Diversification*

"There are now more Hispanics in the U.S. than there are Canadians in Canada, and the Hispanic population in the U.S. will be the largest ethnic population by the year 2010," said Ann Wilkes, vice-president of communications, Snack Food Association, Alexandria, Va. As noted earlier, the growth in the Hispanic population is one of the major shifts under way within the US economy that has and will continue to have an impact on food consumption. More generally, the US food economy is becoming more "ethnic".

- Immigration and cultural diversification have created a high demand for ethnic foods. This trend has already created niche markets for ethnic foods, stressing growth for middle and mass-market brands.
- Cultural diversification will continue to be a significant factor for consumer-pull, driving product development.

The influence of the Hispanic population is especially important for the North American market, as this group is expected to capture 46% of the US population growth over the next 20 years, (see to Figure 25). For example, from 2000 to 2010, there will be 11 million more people of Hispanic origin. This compares to 6 million more of Caucasians, 4 million more of African Americans and 4 million more of Asians.

- Of course, this demographic trend has been a boon to the corn masa industry. As the trend continues to play out, corn masa consumption will at the very least have a core base demand from which sales will be supported.

Figure 23: United States Projected Demographic Shifts

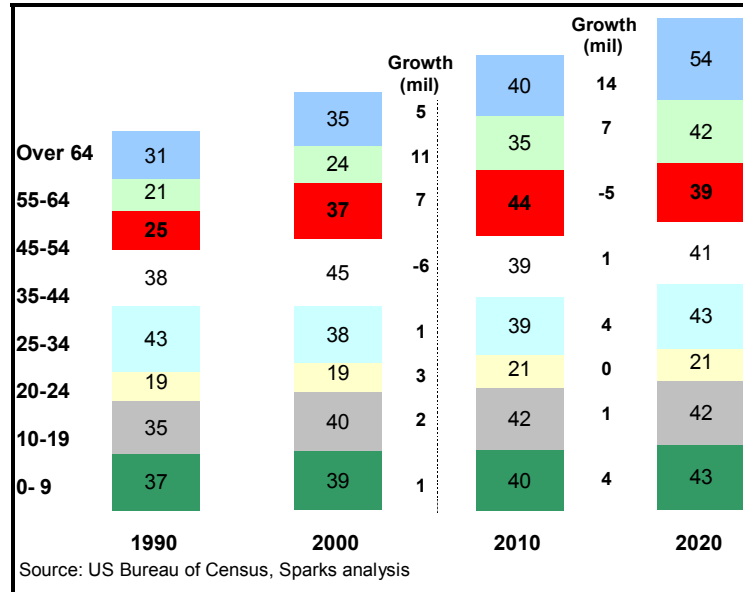


Figure 24: Canada Projected Demographic Shifts

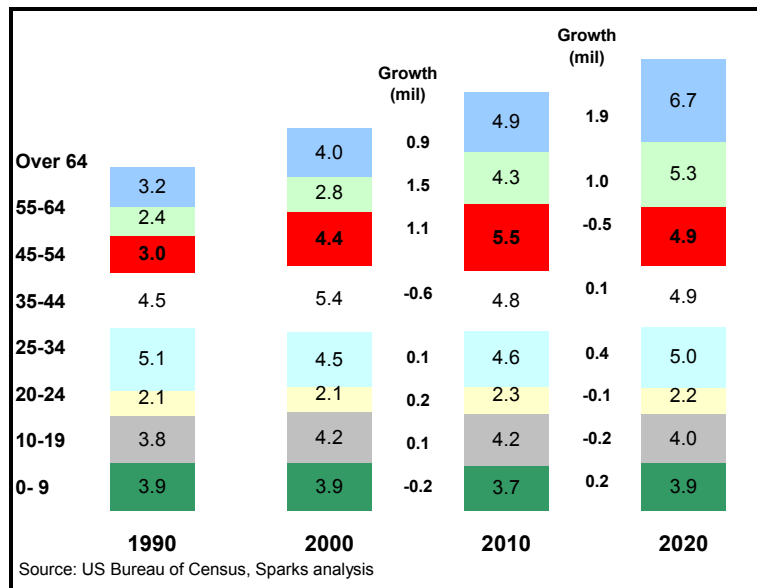
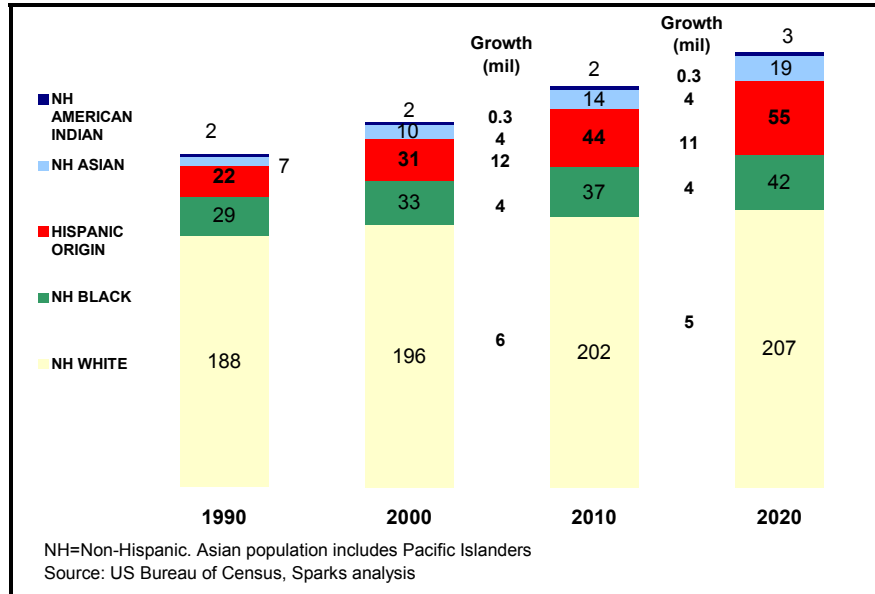


Figure 25: US Projected Population Ethnic Structure Shifts



(3) Changing Lifestyles

- Two significant changes in lifestyles that are having an effect on the type of food/products demanded by consumers are the increasing number of women joining the workforce and the decreasing number of persons-per-household.
- In 1970, less than 50% of women were in the workforce; today, more than 60% of women are in the workforce.
- One of the main factors changing lifestyles with regard to food consumption is the amount of time consumers are allowing themselves to dine, especially during the lunch meal segment – what used to be a lunch hour is now an hour of errands while a meal is consumed.
- Consumers will also continue to dine out more frequently than ever. Hectic schedules and changing lifestyles will force an increasing number of consumers into foodservice establishments. Much of the foodservice growth will likely be at the casual dinner house and family-friendly establishments. The establishments

that could experience the largest share of that growth are the ones that meet the needs of the consumers (quality and variety).

- As a result of these changes, consumers are demanding a different array of products with one common denominator: **convenience**, which is also increasing the number of households that consume more meals outside their homes.
- This demand for convenience will further drive the need for value enhanced corn product development and will emphasize the food service aspect of market development.

#### *(4) Demographic Bubbles*

- Currently, there are 40 million people, ages 10-19, in the US and 4 million in Canada. Teens in the US spend over \$85 billion<sup>2</sup> per year.
- According to the Rand Youth Poll, which has surveyed teens since 1953, spending should increase steadily through 2005 at a rate of at least 4% annually.
- The current teen generation age 10-19 and early college (20-24 years) constitute an uncharacteristically large segment of the population, especially in the US. (They are the offspring of the baby boomers.) Their transition into college and/or work will have a great impact on the products demanded and consequently on the agribusinesses that serves this segment of the population.

### ***3. Implications of Consumer Pull on North American Agriculture and Food Industry***

- The mix of food products “pulled” by consumers is characterized by a rising demand across the board for:
  - **Convenience** products that reduce cooking time. This is a consequence of a change in lifestyle (increased number of working women, decreased knowledge of basic cooking skills among younger generations, positive economic environment and other factors).

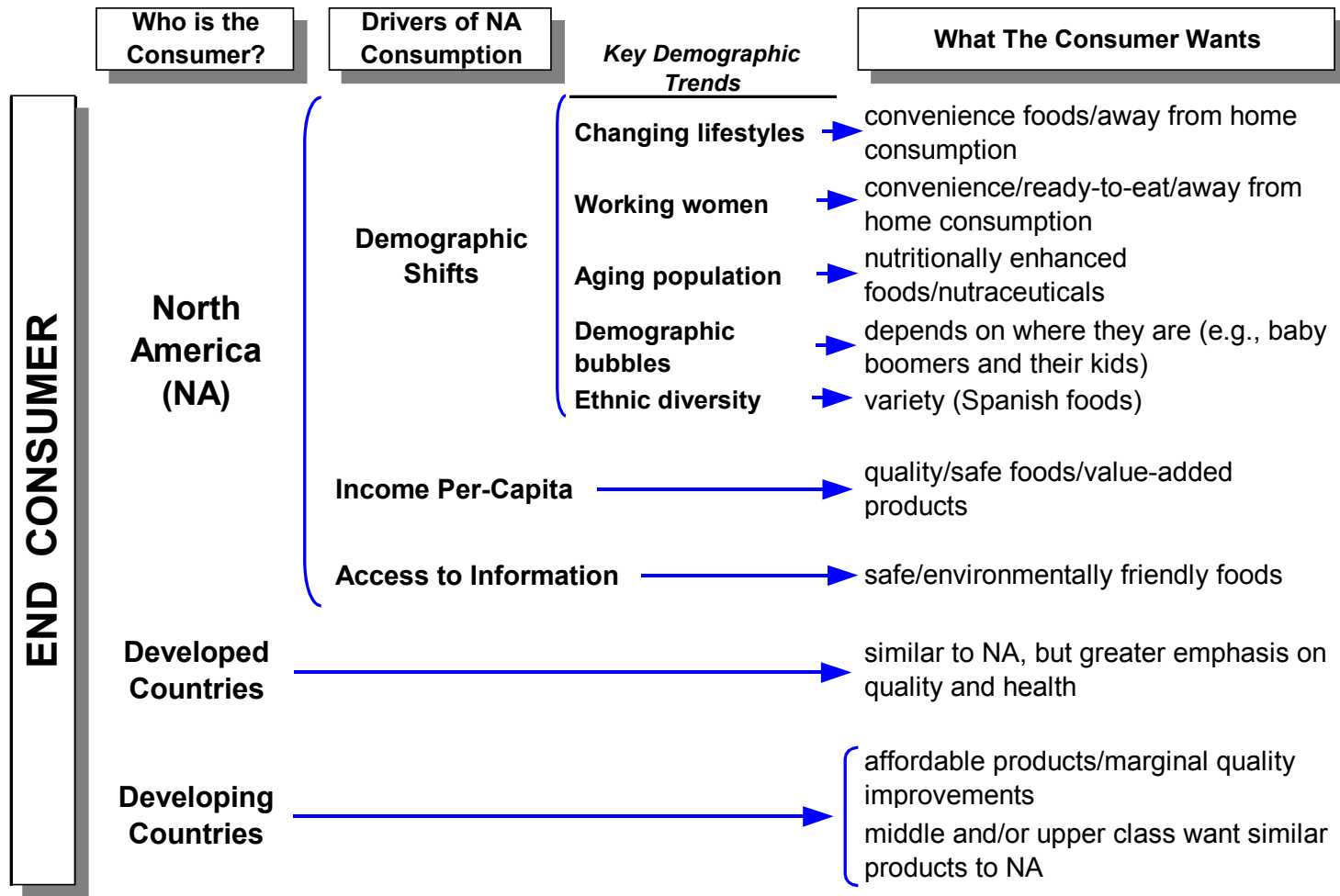
---

<sup>2</sup> Rand Youth Poll and US Bureau of Census.

- **Variety** products, which include more types of processed ethnic foods for food retail and food service. While food preferences are becoming moderately more similar (McDonald's is ubiquitous), the cultural importance and lifestyles often inhibit the rapid adoption of many food products. The North American consumer is becoming more adventurous (sales of Asian foods grew by 25% last year alone), and foodservice operators will offer an ever-widening array of cultures. "No boundaries, no borders" will be the theme, with all sorts of ethnic food served under one roof.
  - **Nutritionally enhanced foods.** An example of a nutritionally enhanced food is the breakfast cereal. Ready-to-eat meals can also be enhanced with vitamins and minerals and satisfy the consumer's need for food supplements.
  - **Quality and safety.** Consumers view food as an "industrial" product in that it needs to be of quality, safe and ready to use.
- A major implication from consumer pull is the relative shift of food consumption from raw foods bought at retail toward fully prepared foodservice items. This change creates opportunity for the innovative and aggressive food processor. Virtually all of the estimated \$100 billion in incremental annual food sales expected in the next decade (2000 – 2010) will come from foodservice, including ready-prepared meals consumed at home.
  - In North America, food processors are already pushing to create "truly" differentiated products to meet consumer needs. In some European countries, such as Spain, food processors have not been very watchful of changing consumer preferences, primarily for convenience foods (value-added products); this creates an opportunity for US and Canadian agribusiness.
  - To take advantage of this dramatic shift in eating habits, restaurant operators, packaged food manufacturers, and the entire US food distribution system will have to make significant changes. The companies that play their cards right, by delivering high-quality prepared foods at reasonable prices, have much to gain. The others may find it difficult to grow or even to survive.

- Figure 26, summarizes some of the dynamics of the North American consumer and compares our market to other parts of the world (developed and developing countries).

Figure 26: Who is The North American Consumer?



Source: Sparks



### **B. Corn Products and Consumption**

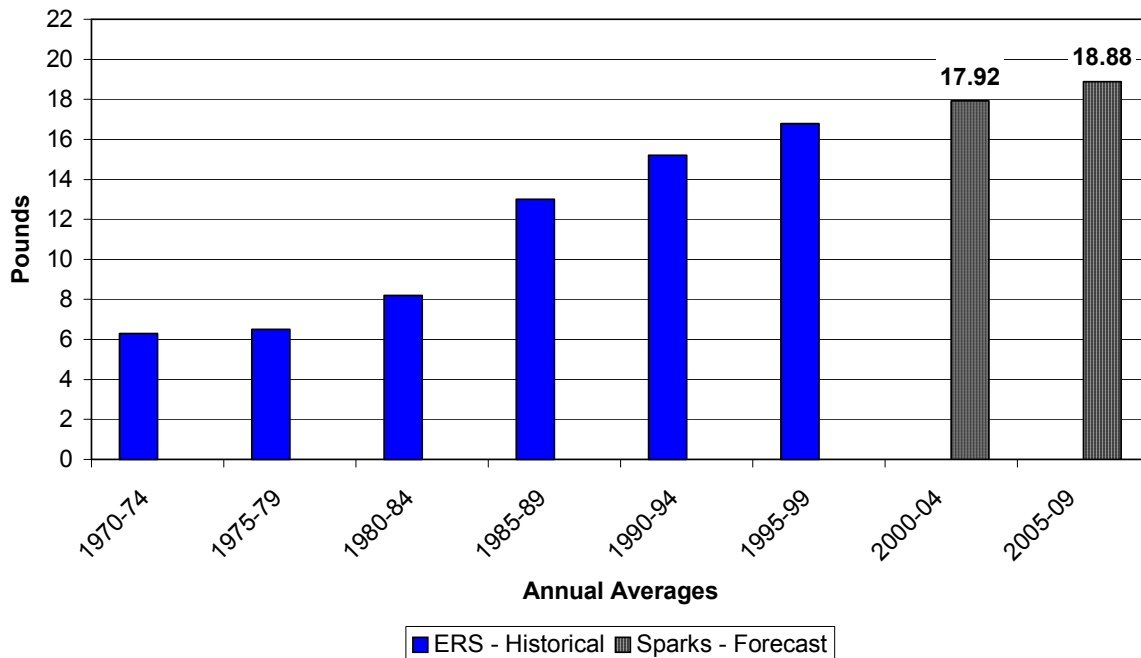
Consumer corn masa demand is considered in the broadest context when analyzing US consumption trends in the data provided by the USDA, ERS. The ERS, subsumes corn masa consumption under the general category of “corn products” and then in the subcategory of “corn flour and meal.” Important to this discussion is an identification of the major patterns of consumption of corn flour and meal, which is heavily influenced by corn masa. What follows is a description of the highlights of the ERS consumption estimates for corn products and corn flour products. Also included are per capita consumption estimates made by Snack Food Association (SFA) regarding tortilla chips.

- The USDA, Economic Research Service (ERS) calculates that the consumption of total “corn products” in the US has risen from an average of 10.2 pounds per capita in 1970-74 to 28.4 pounds per capita in 2000. One of the driving forces in the growth in the level of corn flour products consumption has certainly been the explosion in ethnic foods eaten in the US, i.e., Mexican-style foods and secondly, the consumer’s love affair with snack foods.
- The ERS category of “corn products” is subdivided into three divisions, they are corn flour and meal (which includes masa), hominy and grits, and corn starch. The most significant category in terms of volume of corn products consumed is corn flour and meal. In 1970-74, per capita consumption of corn flour and meal was 6.3 pounds. This rose dramatically to 17.5 pounds per capita in 2000, an increase of 178%. This steady upward trend in the consumption of corn flour and meal is shown in Figure 27, below.
- Sparks estimates that this positive trend in the consumption of corn flour and meal will continue over the next ten years, however, at a slower rate than recently experienced. This assumption is predicated on the fact that much of the rapid growth in corn flour consumption has been a result of the “main street” boost in the demand for Mexican oriented foods. We believe that the marginal growth in “main street” consumption will begin to slow as the market starts to hit a saturation level of Mexican food experiences. The greater (more rapid) growth opportunities for the food industry will occur in the expanding Hispanic population.

## The U.S. Corn Masa Industry

- Compared to the other major ERS categories of flour products, growth in per capita consumption of corn flour has been the greatest, see Figure 28. Since 1970, per capita consumption of corn flour products has increased 150%, this compares to a change of only 31% for wheat (white/whole).
- The Snack Food Association (SFA)<sup>3</sup> estimates that the annual consumption of salty snack foods for 2001 was approximately 22.7 pounds per capita. The second largest salty snack food category (largest, potato chips) and fastest growing category is corn tortilla chips. The significant role that snack foods play in the utilization and consumption of masa corn will be addressed in greater detail in the next section.
- In 1997, tortilla chip consumption averaged 4.9 pounds per capita and in 2001, consumption had increased to 5.3 pounds per capita, up 8.2%. Conversely, potato chip consumption fell from 6.7 pounds per capita to 6.5 pounds per capita in 2001.

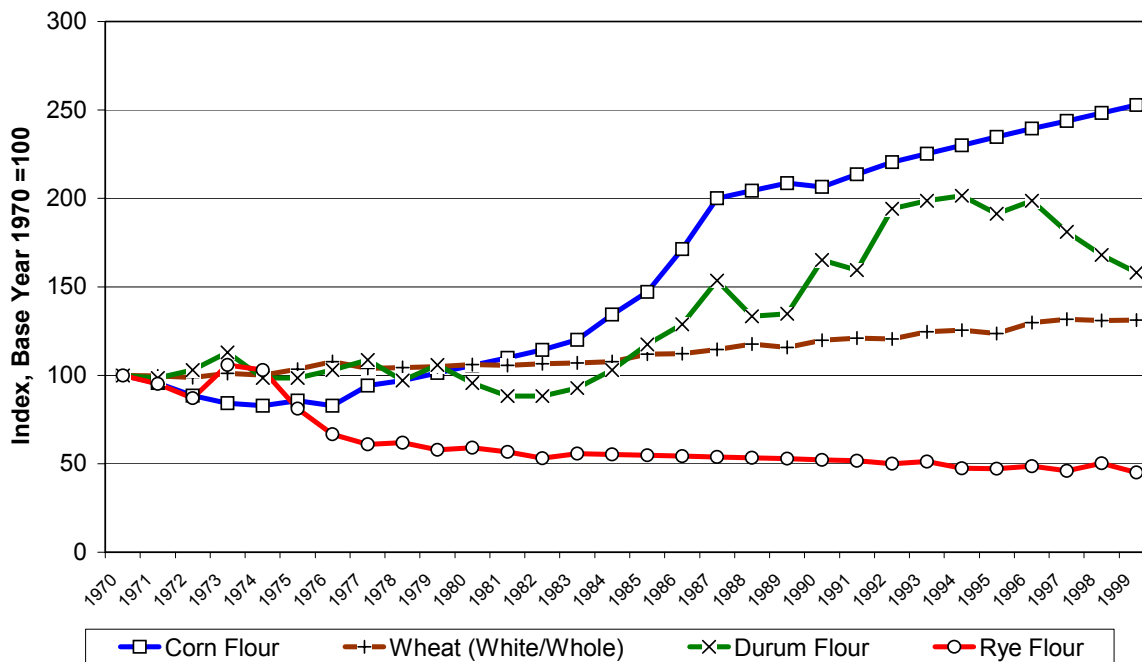
**Figure 27: US Per Capita Consumption: Corn Flour & Meal**



Source: USDA, ERS, Sparks Forecast.

<sup>3</sup> Note: all data and estimates related to snack food consumption comes from the Snack Food Association (SFA).

**Figure 28: Indexation of US Per Capita Consumption of Major Flour Product Categories**



Source: US Census Bureau, USDA, ERS and Sparks.

**C. Overview of Principal Products that use Masa Corn: Tortilla Chips and Tortilla Bread**

As changing diets in the US appear to be under the microscope, it is evident that consumers' love affair with simple carbohydrates displays no signs of slowing. Numerous national health studies have recently validated this love affair after finding that the country is now at extreme levels of obesity within the population ranks. The snack food industry and many of its products have helped to fuel the cravings of our carbohydrate community. In the previous section we discussed the broader categories of corn product consumption as it related to masa corn, in this section we examine more precisely the specific type of products/brands that use masa corn.

As the changing demographic face of America takes place, so too does the change in spending habits. Corn masa has been used as an ingredient for two primary value-added foods, i.e., corn tortilla chips and tortilla bread. Corn tortilla chips are

generally classified as a snack food while tortilla bread is part of bakery products. Tortilla chips were originally made from leftover tortillas when the remaining dough was cut into pieces and fried. The tortilla-making process was developed by early Latin American Indians. "Many scholars think that all of the successful ancient cultures in Latin America developed a process like this for corn," says David Jackson, food scientist at the Institute of Agriculture and Natural Resources, University of Nebraska, Lincoln. Possibly, one of the reasons is that the alkaline corn-processing method increases the availability of B vitamins and proteins and decreases some toxins. Commercial alkali treatments can also significantly increase calcium content, depending on the number of washing steps and the type of alkali used.

- Over the past 10 years, even Mexico's tortilla industry has seen a shift from traditional masa dough to industrial corn flour, from a use level of 21% dry flour in 1991 to 50% in 1997. This is largely due to flour's ease of use and increase in efficiencies, which include: less water consumed; lower industrial waste; better hygiene; extended shelf life (wet dough vs. dry flour); higher yield; lower fuel and labor costs (no cooking facility required); and improved dough consistency (more continuous process, less downtime). Large Mexican manufacturers produce many different types of flour. For example, Grupo Minsa S.A. de C.V., headquartered in Los Reyes Ixtacala, Tlalnepantla, makes 28 different flours, differing in granulation, cooking time/temperature, steeping control, corn hybrids and additives. Hybrids include blue corn, white and yellow. Organic flours come in blue, white and yellow as well. Minsa also produces a dehydrated whole pre-cooked corn-kernel mix for millers to use in masa production.
- In the United States, more than 70% of all corn and tortilla chips start with corn-masa flour, produced by companies such as Grupo Minsa's U.S. operations in Red Oak, IA and Muleshoe, TX; Gruma SA de CV, San Pedro, Garza García, Mexico, (Azteca Milling, Irving, TX); Cargill, Minneapolis; ConAgra, Omaha, NE; and Quaker Oats, Chicago.

While potato chips continue to be the segment leader on the snack food chart, tortillas have seen their importance rise to almost equal levels as the potato chips. This trend is due in part to changing demographics, but mostly it is due to a general acceptance among the populous of Hispanic flavored/influenced items. In Figure 29, the data shows that the "tortilla/tostada" snack segment is clearly the second largest

## The U.S. Corn Masa Industry

---

in annual sales at \$4.1 billion, compared to “potato chips” at \$6.0 billion, the third largest category is “meat snacks” at \$2.0 billion.

**Figure 29: US Salted Snack Sales, 2001 (Sales and Volume)**

<b>Segment</b>	<b>Dollar Sales (In Millions)</b>	<b>Pound Volume (In Millions)</b>
Potato Chips <sup>(1)</sup>	\$6,039.2 (+7.0%)	1,848.6 (+3.0%)
Tortilla/Tostada Chips	\$4,148.2 (+5.0%)	1,501.9 (+1.3%)
Corn Snacks	\$933.7 (+2.1%)	279.1 (-0.3%)
Pretzels	\$1,204.1 (+0.9%)	580.1 (-1.1%)
Snack Nuts	\$1,839.6 (+1.5%)	515.9 (+2.3%)
Microwave Popcorn	\$1,273.3 (+2.2%)	453.9 (+1.3%)
RTE Popcorn	\$466.9 (-4.8%)	124.5 (-5.1%)
Unpopped Popcorn	\$78.1 (-2.8%)	87.1 (-3.9%)
Cheese Snacks	\$1,027.1 (+3.7%)	332.6 (+2.5%)
Pumpkin/Sunflower Seeds	\$138.3 (+5.5%)	52.4 (+2.4%)
Meat Snacks	\$2,011.2 (+15.6%)	139.5 (+14.9%)
Pork Rinds	\$498.5 (-2.6%)	87.7 (+0.7%)
Variety Pack	\$345.9 (-0.5%)	76.6 (-11.8%)
Other	\$1,794.2 (+3.5%)	392.4 (-1.6%)
<b>All Snack Sales</b>	<b>\$21,798.3 (+5.1%)</b>	<b>6,468.3 (+1.4%)</b>

<sup>(1)</sup> Includes potato chips and potato

*Source: Snack Food & Wholesale Bakery magazine, Information Resources Inc., Snack Food Association, ACNielsen, all retail channels*

Tortilla-chip sales boomed in the '90s, enjoying double-digit growth even as other categories plateaued. According to the Snack Food Association (SFA), Alexandria, VA, the snack-food industry is now a more than \$21.8 billion enterprise, led respectively by potato chips, tortilla chips and pretzels. According to ACNielsen, Stanford, CT, 89% of U.S. households purchase potato chips, with a re-purchase rate of every three weeks. This is followed by 76% purchasing tortilla chips every 32 days and 63% purchasing pretzels every 37 days. Naturally, families with children and teenagers are the largest consumers.

## The U.S. Corn Masa Industry

---

- PepsiCo's Frito-Lay, Inc., Plano, TX, dominates the U.S. tortilla-chip industry, with 57.5% of the market. Frito-Lay possesses 81% of the country's top brands by volume, despite challenges from several big-name competitors such as Keebler, Eagle Snacks and Borden. The company's Dorito's®, which were introduced in 1966, had estimated retail sales of \$1.7 billion in 1995. Tostito's® tortilla chips were introduced in 1981, and estimated retail sales in 1995 were \$754 million. See Table 2, for an overview of the top selling brands.
- According to the most recent figures from Schaumburg, Ill.-based ACNielsen, during the past four years, tortilla chip consumption has increased steadily, averaging a growth of nearly 2.5% each year.

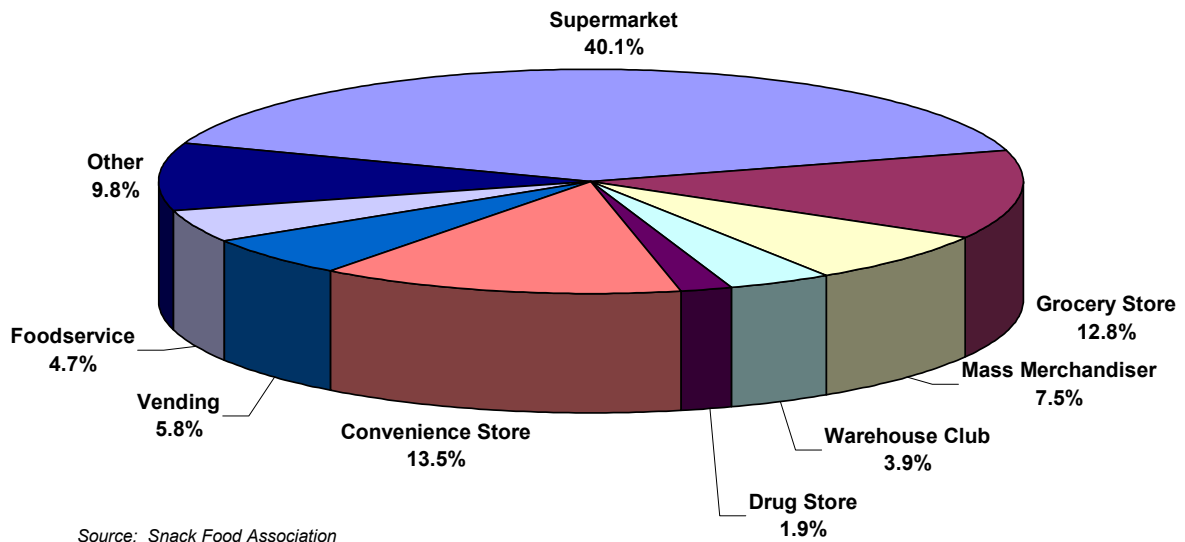
**Table 2: Top 10 Brands of US Tortilla/Tostada Chips (Based on Dollar Sales), 2001**

Top 10 Brands	Dollar Sales	Dollar Sales % Chg Prior Yr
Doritos Tortilla/Tostada Chips	\$785,697,536	4.80%
Tostitos Tortilla/Tostada Chips	\$679,127,232	17.90%
Private Label Tortilla/Tostada Chips	\$78,567,336	-1.40%
Santitas Tortilla/Tostada Chips	\$57,586,352	10.70%
Baked Tostitos Tortilla/Tostada Chips	\$58,802,880	-30.40%
Mission Tortilla/Tostada Chips	\$52,073,692	27.70%
Tostitos Wow Tortilla/Tostada Chips	\$30,894,808	-27.10%
Doritos Wow Tortilla/Tostada Chips	\$25,896,062	-35.50%
Padrinos Tortilla/Tostada Chips	\$20,241,438	-16.50%
Old Dutch Tortilla/Tostada Chips	\$14,478,759	20.80%

Source: Information Resources Inc., including supermarket, drug, mass merchandiser, excluding Wal-Mart. Because Wal-Mart no longer supplies scanning data to IRI, this year's charts cannot be compared to charts in previous years.

Once considered an ethnic food by many, tortilla chips have become a staple at parties, are giving potato chips a run for their money and are a standard menu item in nearly every restaurant in the country. As Figure 30, below shows, retail channels have been the most important outlet for tortilla chip sales. The supermarket and grocery store venues account for over 50% of all annual chip sales. The warehouse club sector, which includes Costco's and Sam's (Wal Mart) has approximately 4% of the market. The club category will likely expand market their share at the expense of the supermarket and grocery store categories as more stores open and club converts are gained. As noted earlier, food service use of chips will probably slow as the restaurant market for Mexican style foods matures. This suggests that the demand base for corn masa products, such as tortilla chips will increasingly come from food retail outlets.

**Figure 30: Tortilla Chips, Distribution (volume) by Outlet**



Somewhat lost in the shuffle is a discussion related to the consumption of tortilla bread. Tortilla bread can be made with either masa corn flour or wheat flour. Most people identify with the tortilla “wraps”, for example, Taco Bell burritos, which uses wheat flour as the base ingredient. The wheat gluten acts a binder to keep the tortilla flexible and strong to hold the wrapped food, like beans or meat. The wrap sector has grown very well with the expansion into many channels of food

## ***The U.S. Corn Masa Industry***

---

distribution. Masa corn tortillas, on the other hand, are served in traditional Mexican restaurants (not chain restaurants) and in Hispanic homes, they don't have the same "elastic" properties as wheat tortillas. We know from the growth in Hispanic population that this sector has also shown favorable consumption patterns. Despite the fact that wheat tortillas and masa corn tortillas are made with different primary ingredients, they are both classified as a baked product. What follows is a review of both wheat and masa corn "tortillas" lumped into the same classification. The data comes from the Tortilla Industry Association, but unfortunately, the type of flour used in the tortillas is not differentiated.

- The tortilla industry is the fastest growing sector in the U.S. baking industry.
- In 2000, tortilla sales in the U.S. reached the \$4.4 billion mark and are expected to hit \$5.7 billion dollars in sales by the year 2002.
- Tortilla Industry Association (TIA) estimates that Americans consumed approximately 85 billion tortillas in 2000 (not including tortilla chips)
- More than 300 companies in the U.S. are devoted to making tortillas.
- Other bakery categories and their level of sales are summarized in Table 3.



**Table 3: US Bakery Sales**

(For 52 weeks ending December 30, 2001)

<b>Category</b>	<b>Dollar Sales (In Millions)</b>	<b>% Change</b>	<b>Private Label Sales</b>	<b>% Change</b>	<b>Market Share</b>
Bread	\$5,623.3	+2.4	\$1,519.4	+5.6	27.0
Buns	\$919.7	+4.8	\$438.2	+6.4	47.6
Rolls	\$143.6	+0.5	\$47.3	+10.1	32.9
Crackers	\$3,301.8	+1.8	\$245.4	0.0	7.4
Cookies	\$3,973.7	-0.5	\$338.8	-0.4	8.5
English Muffins	\$410.1	+2.2	\$56.7	+4.0	13.8
Fresh Bagels	\$436.3	+2.7	\$64.6	-5.0	14.8
Frozen Bagels	\$130.5	-10.3	\$16.6	-11.4	12.7
Donuts	\$563.9	+4.6	\$80.3	+8.7	14.2
Snack Cakes	\$640.5	+0.2	\$57.8	+14.7	9.0
Snack Pies	\$85.5	-1.0	\$14.7	-5.5	17.2
Danish	\$118.4	-0.2	\$21.3	+18.0	18.0
Muffins	\$168.1	+2.2	\$90.9	+2.1	54.1
Coffee Cake	\$144.3	+4.6	\$31.3	+37.4	21.7
Frozen Bread	\$319.7	+16.4	\$30.9	+26.9	9.7
Frozen Pies	\$318.8	+9.2	\$5.6	+20.6	1.8
Frozen Sweet Goods	\$321.1	-0.9	\$7.6	+5.1	2.4
Frozen Pizza	\$2,581.3	+5.9	\$153.4	+13.9	5.9
Frozen Appetizers/Snacks	\$711.4	+12.0	\$23.3	+112.3	3.3
Frozen Pretzels	\$32.4	-0.4	\$3.2	+0.1	9.8
RFG Appetizers/Snacks	\$121.7	+12.9	\$6.1	+67.6	5.0
RFG Pizza	\$114.6	-11.0	\$10.4	-36.6	9.1

Source: Information Resources Inc.

**References**

American Association of Cereal Chemists. Corn: Chemistry and Technology, Edited by Stanley A. Watson and Paul E. Ramstad, 1991.

U.S. Feed Grains Council. 1995-1996 Value Enhanced Corn Quality Report, 1996.

U.S. Feed Grains Council. 1996-1997 Value Enhanced Corn Quality Report, 1997.

U.S. Feed Grains Council. 1997-1998 Value Enhanced Corn Quality Report, 1998.

U.S. Feed Grains Council. 1998-1999 Value Enhanced Corn Quality Report, 1999.

U.S. Feed Grains Council. 1999-2000 Value Enhanced Corn Quality Report, 2000.

U.S. Feed Grains Council. 2000-2001 Value Enhanced Corn Quality Report, 2001.

U.S. Feed Grains Council. 2001-2002 Value Enhanced Corn Quality Report, 2002.

U.S. Feed Grains Council. 2002-2003 Value Enhanced Corn Quality Report, 2003.

Milling & Baking News,. Grain & Milling Annual 2002, (Sosland Publishing Company, 2001).

Snack Food Association. Snack World June 2001 State of the Snack Food Industry, (Cygnum Publishing, Inc).

U.S. Census of Manufacturing. Web Database.

USDA, FAS. Web Database.

USDA, NASS. Web Database.

USDA, ERS. Web Database.

U.S. Department of Commerce. Web Database.