

ARS Non-Food, Non-Fuel Processing Research Opportunities

Sevim Z. Erhan

**National Center for
Agricultural Utilization
Research
USDA/ARS, Peoria, IL**



- **The strengths of ARS in the area of non-food/non-fuel research**
- **Discuss broad recommendations for future areas of focus for ARS over the next 5-7 years**
- **Stimulate discussion of possible Research Projects in the light of growing demands for biofuels, need for food and increasing prices of petroleum products**

Current ARS Activities:

- **Vegetable oils**
- **Starch and saccharides**
- **Plant materials and fibers**
- **Cotton and cotton fibers**
- **Processing**
- **Hides/leather/wool/proteins**
- **Fungus, pest and disease**

Global Vegetable Oil Use

	1994/95	2004/05	10-year Growth	2004/05 share
Soybean	19.46	32.20	65	29
Palm	14.74	33.18	125	30
Rapeseed	10.35	15.82	53	14
Sunflowerseed	8.04	9.09	13	8
Cottonseed	3.68	4.79	30	4
Peanut	4.24	4.91	19	4
Palm kernel	1.95	4.01	106	4
Coconut	3.37	3.27	-3	3
Olive	1.88	2.74	46	2
Total	67.70	110.00	62	100

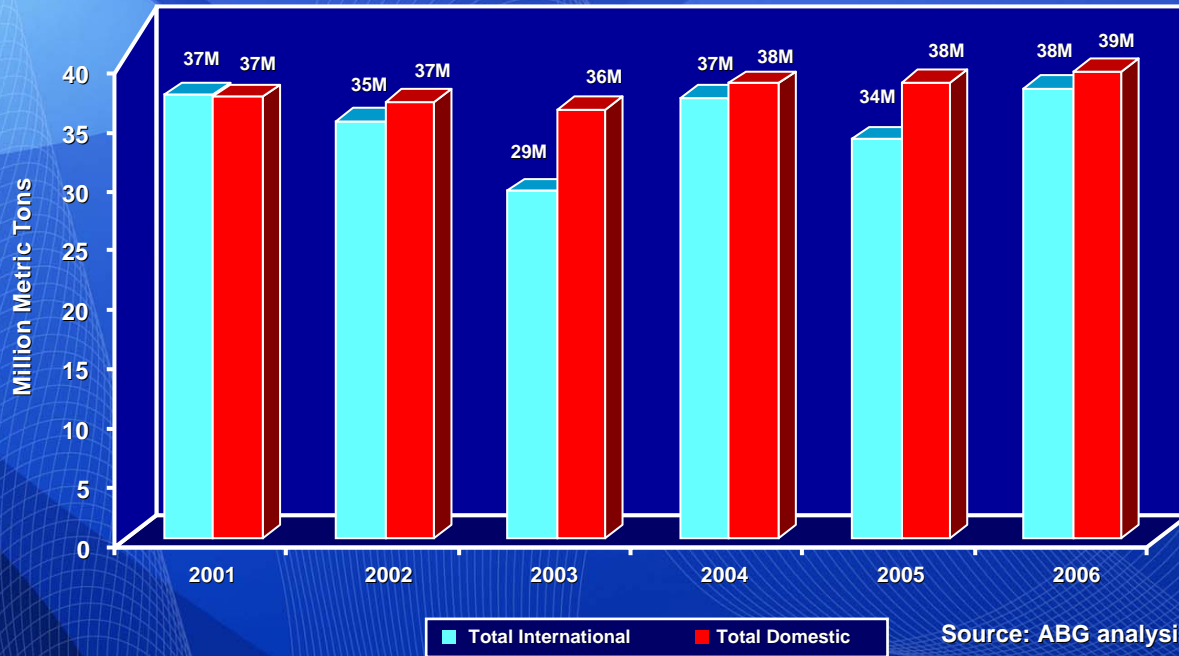
Source: Foreign Agricultural Service, USDA

Baseline Prices (Mean Season Average Prices)

	2008	2009	2010	2011	2012	2013
Soybean (\$/bu)	6.70	6.69	6.64	6.53	6.49	6.41
Corn (\$/bu)	3.02	3.07	3.08	3.09	3.07	3.06
Wheat (\$/bu)	4.11	4.18	4.22	4.27	4.31	4.34
Cotton (\$/lb)	0.519	0.519	0.520	0.521	0.531	0.545
Rice (\$/cwt)	8.18	8.55	8.59	8.61	8.78	8.98
Barley (\$/bu)	3.09	3.10	3.08	3.07	3.05	3.05
Oats (\$/bu)	1.88	1.91	1.92	1.93	1.92	1.92
Peanuts (\$/lb)	0.218	0.221	0.218	0.216	0.216	0.216
Sorghum (\$/bu)	2.82	2.88	2.89	2.92	2.92	2.94
Sunflower (\$/cwt)	13.69	13.86	13.68	13.37	13.16	12.94

The price predictions for other commodities over next 5 years is shown here.

Global Consumption of US Produced Soybean Over 2001-2006



International and domestic consumption has been increasing continuously due to a higher demand from emerging economies, especially China.

Soybean Consumption Over Last Five Years

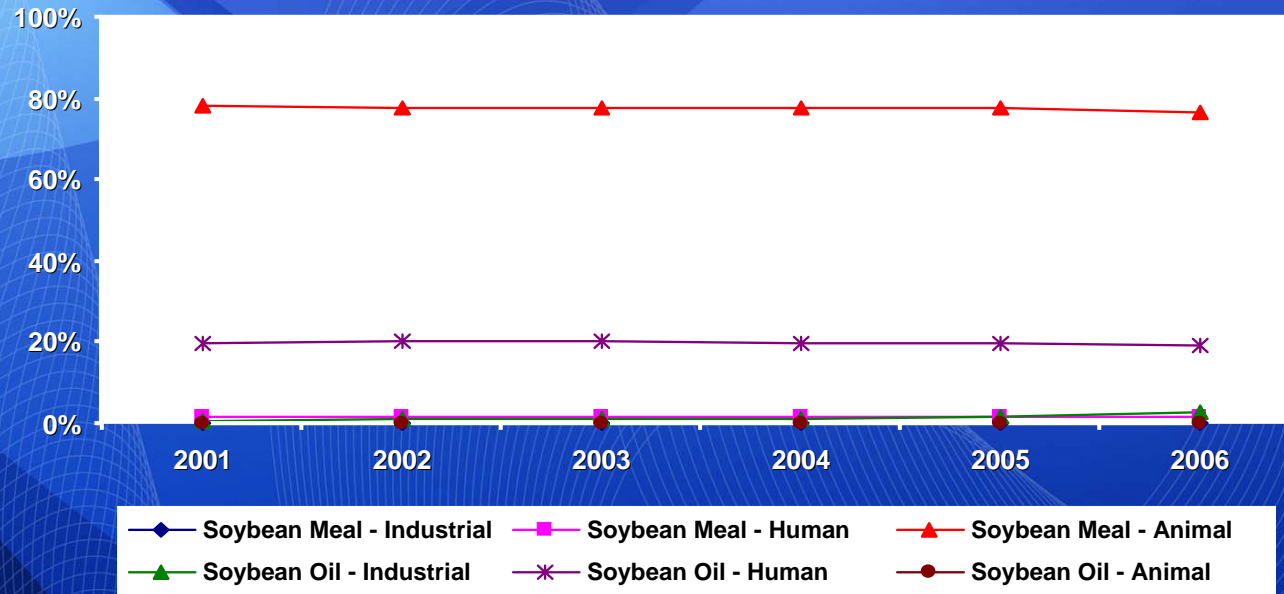
	2001	2002	2003	2004	2005	2006	CAGR
Animal	28.96	28.53	27.97	28.95	29.71	30.15	0.67 %
Human	7.94	7.96	7.86	8.08	8.10	8.12	0.37 %
Industrial	0.27	0.35	0.34	0.41	0.59	1.11	26.57%

Note: All numbers in million metric tons; CAGR: compounded annual growth rate

Source: ABG-United Soybean Board Soybean Market View Database, September 2007

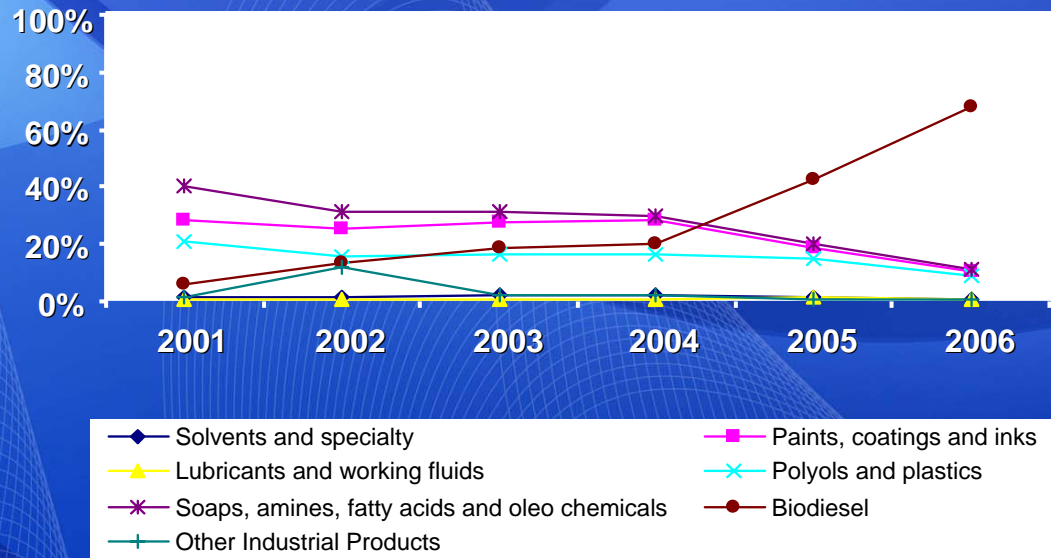
Industrial consumption has been growing at a fast pace with a 26.57% growth rate.

U.S. Soybean Utilization by Segment



Source: ABG-United Soybean Board Soybean Market View Database, September 2007
About 98% of soybean meal is used for animal feed, while the remaining 2% is used for human food (bakery ingredients, meat substitutes and specialty items such as tofu) or industrial products. Human consumption of soybean is mainly in the form of oil. 87% of domestic soybean oil is consumed by humans, while remaining 13% is used in industries.

Soybean Domestic Industrial Consumption



Source: ABG-United Soybean Board Soybean Market View Database, September 2007
Major growth in industrial consumption is because of biodiesel. Apart from biodiesel, lubricants show a compounded annual growth rate of 32%, followed by 16% for solvents and specialty; 10% for polyols and plastics, 7% for paints, coatings and inks, and 2% for soaps, amines, etc., showing their contribution to enhance the soybean industry's role as a major feedstock supplier.

New Crops Seed Oils

New Crops	Oil content	Potential alternative to
Meadowfoam	20-30%	-
Lesquerella	24%	castor oil
Cuphea	25%	coconut and palm kernel oils
Field pennycress	36-40%	Rapeseed oil

U.S.A. Food and Industrial Uses of Corn in Fiscal Years 2004 – 2006, Compared with 2000 (in mt x 10³) (by USDA – FAS, Published in Corn Annual 2005/ 06)

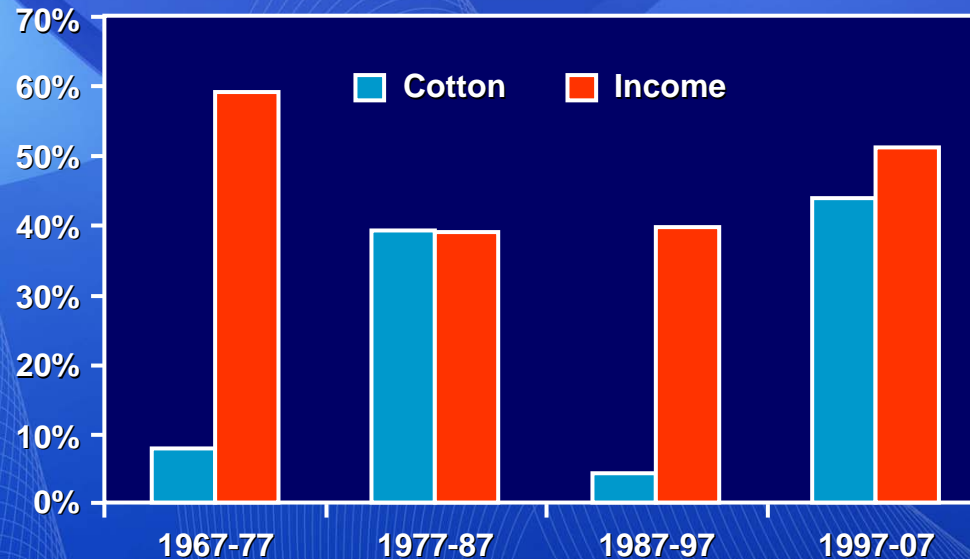
Fiscal Year	2000	2004	2005	2006
HFCS	13,462.0	13,233.4	13,589.0	16,639.8
Glucose/dextrose	5,537.2	5,638.8	5,715.0	5,756.8
Starches	6,273.8	7,061.2	7,112.0	7,239.0
Fuel alcohol	19,951.2	33,604.2	49,640.0	54,610.0
Beverages, alc.	3,302.0	3,378.2	3,429.0	3,429.0
Cereals/food*	4,699.0	4,806.0	4,826.0	5,003.8
Total	49,225.2	67,716.4	75,311.0	89,535.0

* Breakfast cereals and other cereal food.

Source: Corn Annual Report, 2005, Corn Refiners Assoc., Inc., 1701 Pennsylvania Ave., N.W., Washington D.C.; Corn Annual Report, 2006, Corn Refiners Assoc., Inc., 1701 Pennsylvania Ave., N.W., Washington D.C. 20006–5805, web site: <http://www.corn.org>.

The main outlets of corn starch in food and industrial uses for the last three years shows that the only industrial use, which has grown three-fold is fuel ethanol, while all other uses remain constant.

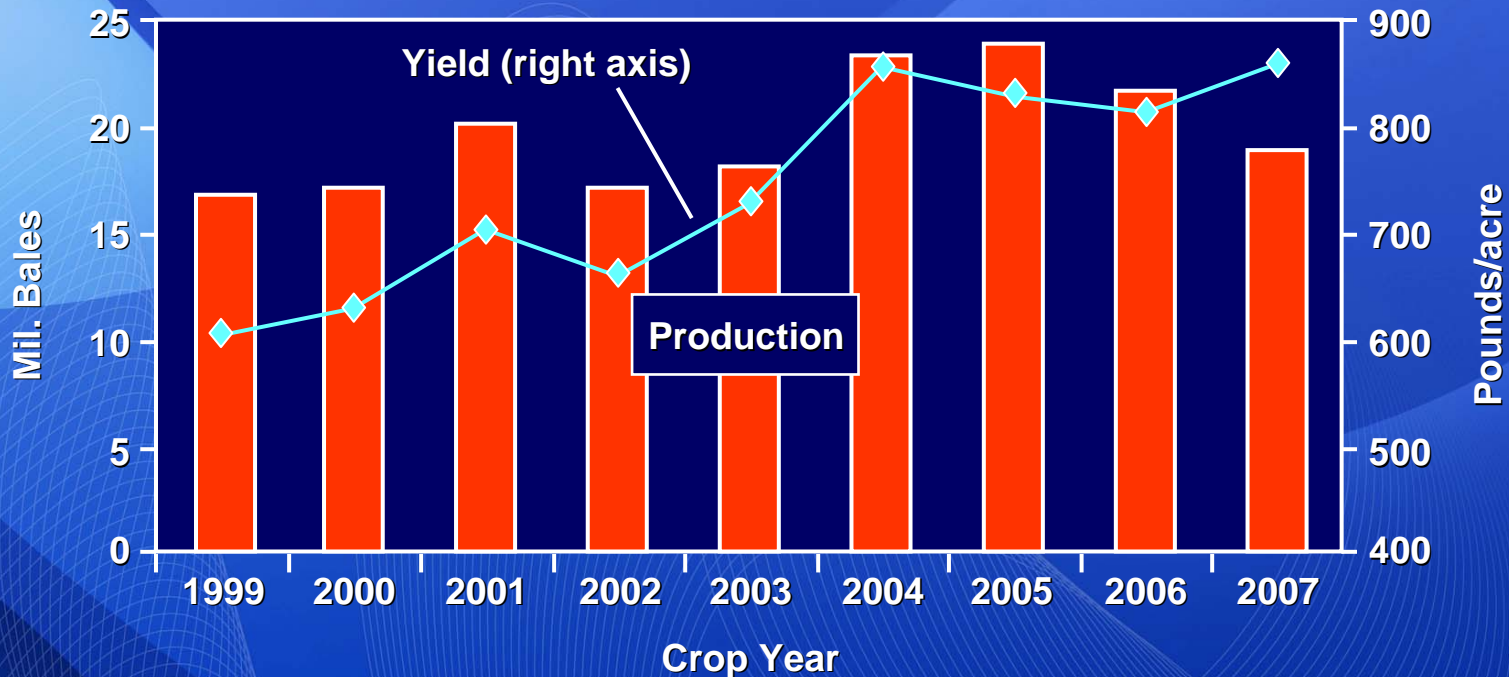
Global Income and Cotton Consumption



Sources: International Monetary Fund and Interagency Commodity Estimates Committee, USDA

While world cotton consumption expanded 43 percent during the most recent decade, it grew only 7 percent during the earlier period.

U.S. Cotton Production and Yield

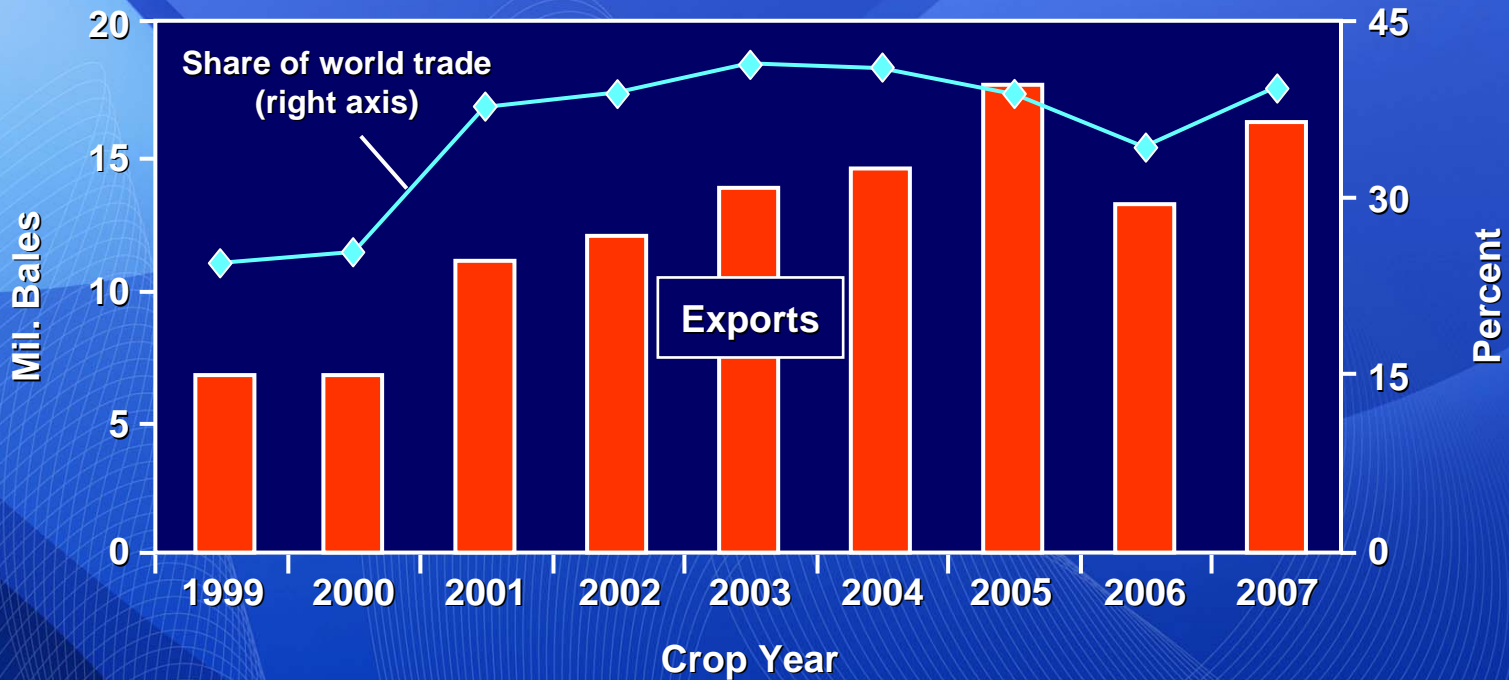


2007 estimated.

Source: National Agricultural Statistics Service, USDA.

After three consecutive seasons with U.S. cotton production over 21 million bales, stocks rose considerably leading up to the 2007 season. In 2007/08, higher expected net returns offered from some competing crops (corn and soybean) helped cut cotton planted area nearly 30 percent from 2006/07. Cotton area has remained high despite relatively low prices for cotton relative to other crops, as improved yields sustain profitability.

U.S. Cotton Exports

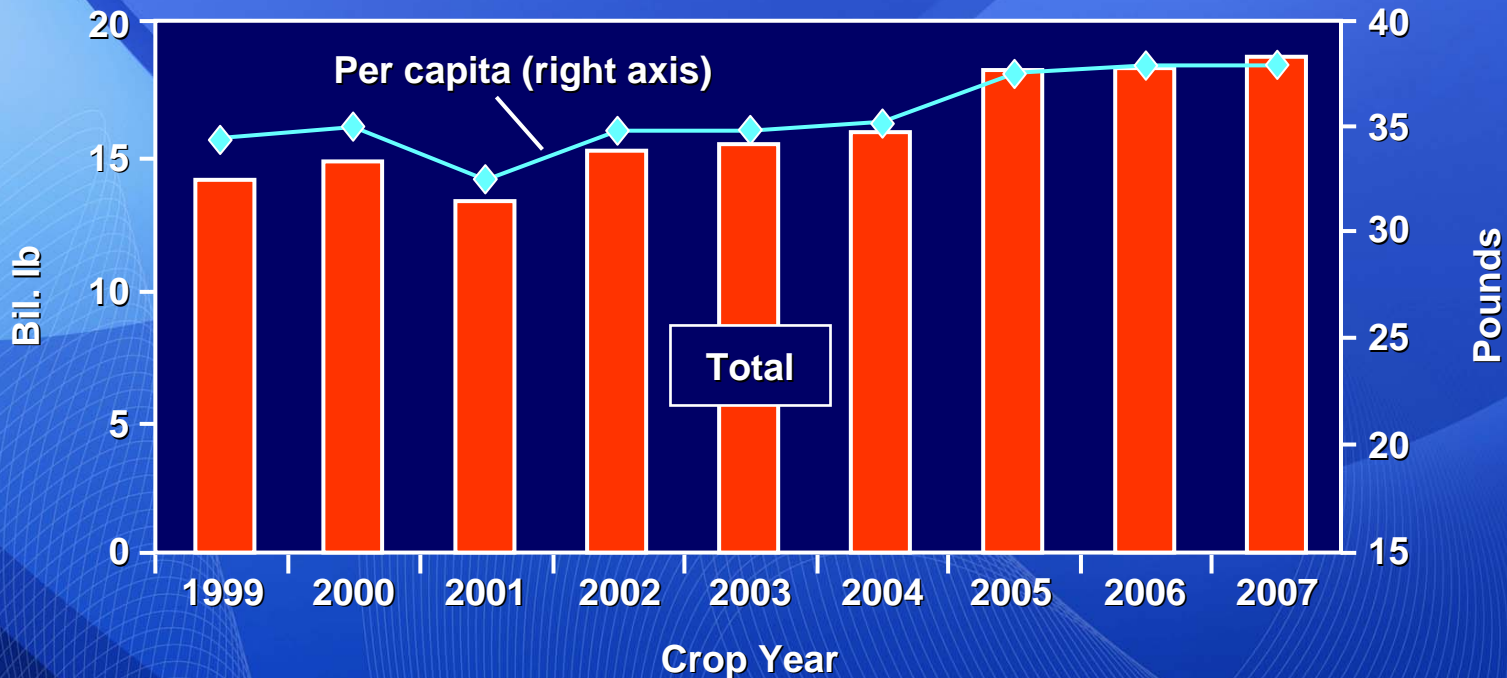


2007 estimated.

Source: National Agricultural Statistics Service, USDA.

U.S. cotton exports are forecast at 16.2 million bales. 3.2 million (nearly 25 percent) above 2006/07. With prospects of world trade rising 9 percent in 2007/08, to 41.1 million bales, the U.S. share of global trade is forecast to reach 39 percent, up from 35 percent in 2006/07 but equal to that of 2005/06.

U.S. Cotton Domestic Demand



2007 estimated.

Source: National Agricultural Statistics Service, USDA.

Total domestic demand (mill use plus net textile trade) of cotton in 2007 is expected to remain near last year as the increase in imports is offset by the decrease in fiber mill use and textile exports.

Cotton domestic demand is likely to remain near the record set in calendar year 2006 of 11.3 billion pounds. In addition, less than 20 percent of this total was spun in the United States in 2007, compared with about 60 percent just a decade ago.

U.S. Wool Supply and Use, Clean Content, 2003-2006

Item	2003	2004	2005	2006
	Million pounds			
Stocks ¹				
January 1	53.5	43.4		37.5
Production	20.2	19.9	19.7	19.0
Imports	20.7	22.7	18.4	17.3
Unaccounted	10.0	10.0	10.0	10.0
Total supply	104.4	96.0	89.9	83.8
Mill use ²	49.9	43.0	40.0	33.0-39.0
Exports	11.1	11.2	12.4	18.0
Total use	61.0	54.2	52.4	51.0-55.0
Stocks: December 31	43.4	41.8	37.5	28.8-32.8

¹ Estimated by USDA. All projections are rounded. Last wool stocks survey was conducted in 1994.

² Estimated by USDA beginning in 2003.

Sources: USDA and USDC, U.S. Census Bureau.

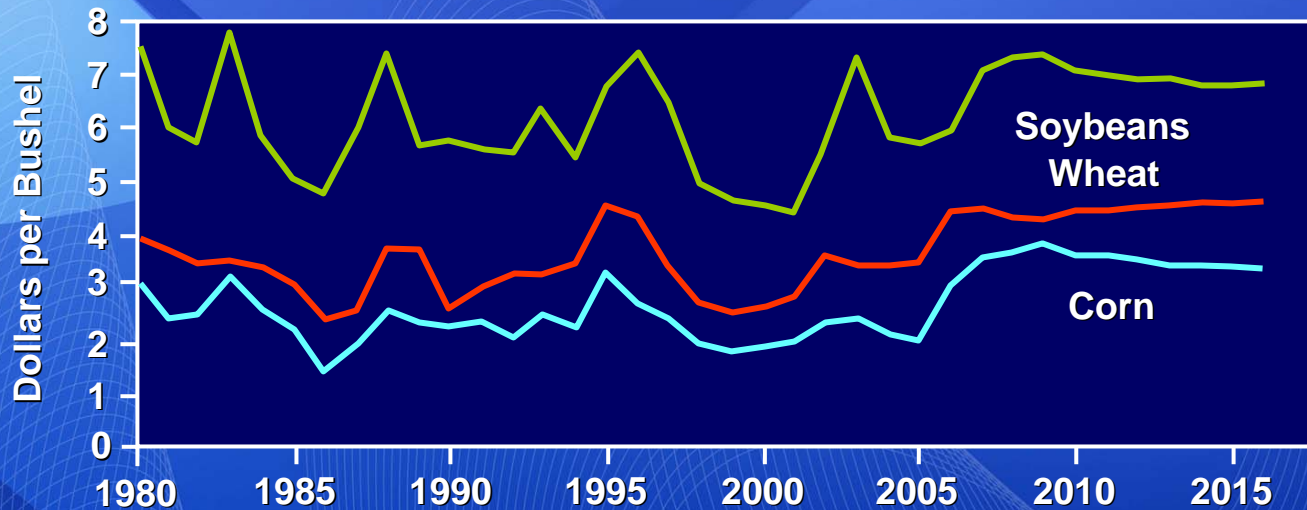
Based on historical supply and demand relationships, wool use likely declined in 2006. Total raw wool consumption in 2006 is estimated at 33.0 million to 37.0 million pounds (clean), 12.5 percent below estimated 2005 wool use. Wool production declined 3 percent, to 36.0 million pounds (greasy) for the 2006 marketing year. Raw wool exports in 2006 were 18.0 million pounds (clean), compared with 12.4 million a year earlier.

Inventory of Major Potential World Fiber Sources [Rowell]

Source	World (dry metric tons)
Wood	1,750,000,000
Straw (wheat, rice, oat, barley, rye, flax, grass)	1,145,000,000
Stalks (corn, sorghum, cotton)	970,000,000
Sugar cane bagasse	75,000,000
Reeds	30,000,000
Bamboo	30,000,000
Cotton staple	15,000,000
Core (jute, kenaf, hemp)	8,000,000
Papyrus	5,000,000
Bast (jute, kenaf, hemp)	2,900,000
Cotton linters	1,000,000
Esparto grass	500,000
Leaf (sisal, abaca, henequen)	480,000
Sabai grass	200,000
TOTAL	4,033,080,000

Bio-based resources that could be utilized for bio-based products.

Future Projection Corn, Wheat, and Soybean Prices

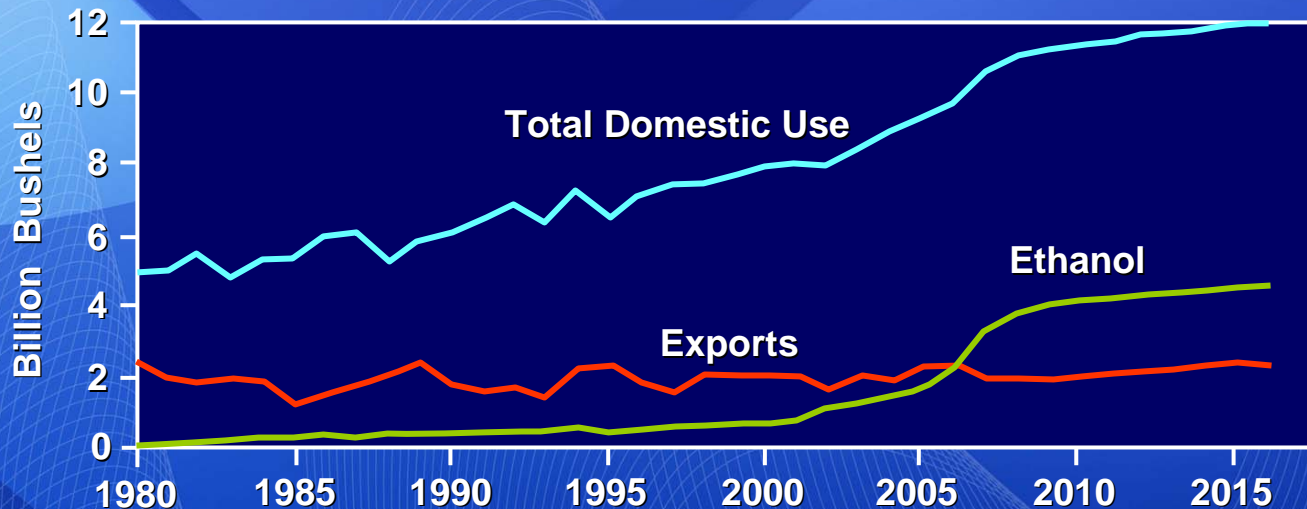


Corn prices rise sharply through 2009/10 as increases in ethanol production strengthen corn demand. In the longer run, higher acreage and gains in yields are sufficient to meet slower ethanol production gains and moderate export growth, resulting in falling prices for corn.

In the longer run, soybean prices are projected to fall back somewhat due to supply response in South America.

Wheat prices are held high in the early years of the projections despite somewhat higher production as higher corn prices support wheat prices by encouraging increased wheat feed use.

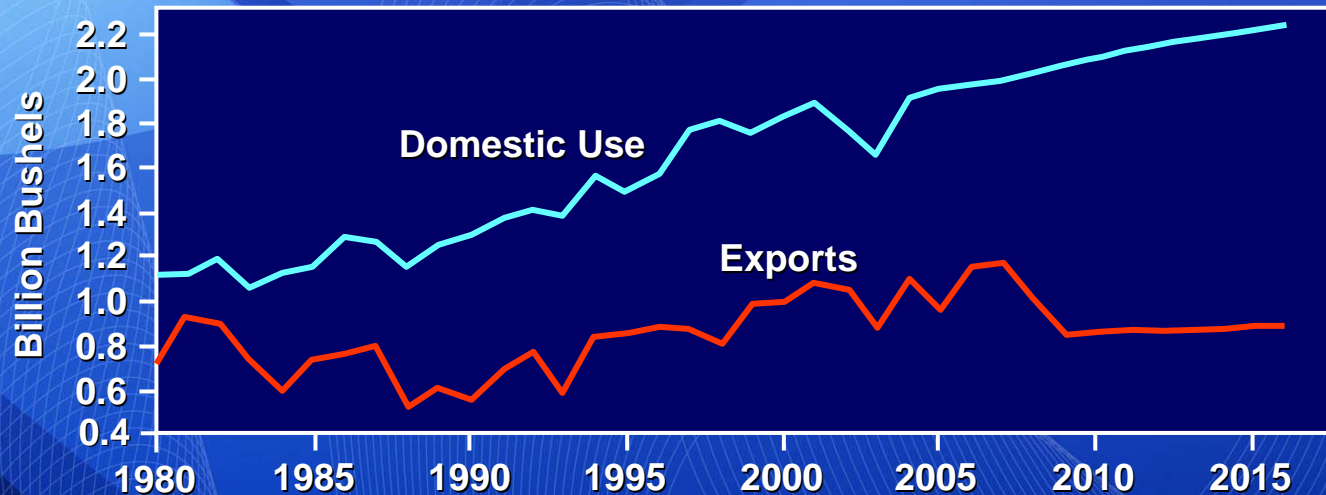
Domestic Use and Exports of Corn



Domestic corn use grows throughout the projection period, primarily reflecting increases in corn used in the production of ethanol. Feed and residual use of corn declines in the initial years and then rises only moderately as increased feeding of distillers' grains, a coproduct of dry mill ethanol production, helps meet livestock feed demand. Gains in food and industrial uses of corn (other than for ethanol production) are projected to be smaller than increases in population.

Export falls over the next several years as more corn is used domestically in the production of ethanol. After growth in ethanol production in the United States slows, U.S. corn exports rise in response to stronger global demand for feed grains to support growth in meat production.

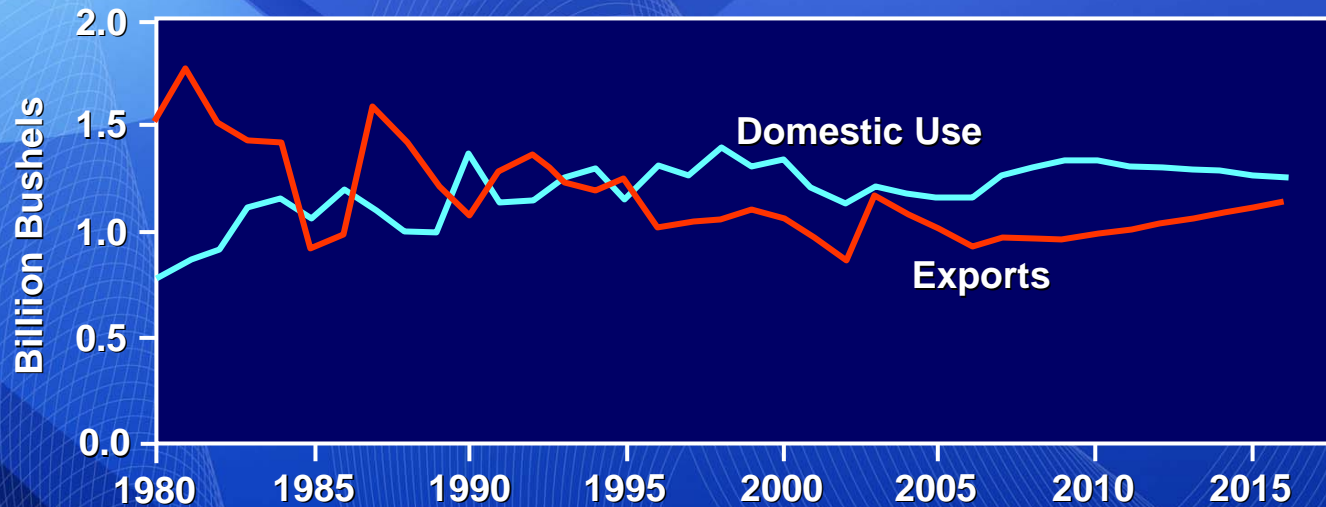
Domestic Use and Exports of Soybeans



Domestic use of soybeans continues to rise slowly, but U.S. soybean exports initially fall and then grow very slowly.

U.S. soybean exports fall below 900 million bushels as U.S. acreage is shifted to corn to support ethanol production and competition from Brazil.

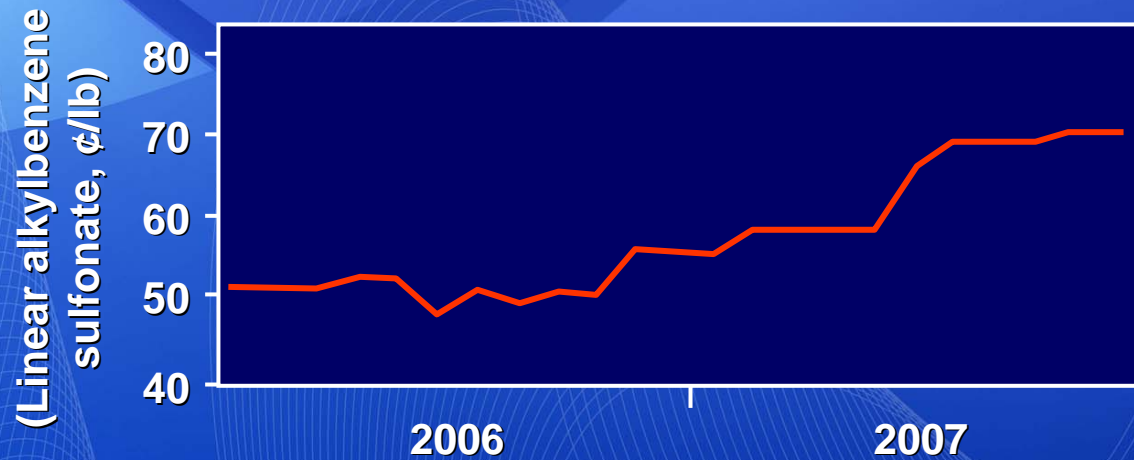
Domestic Use and Exports of Wheat



Overall demand in the U.S. wheat sector will grow very slowly through the next 10 years, as it reflects a relatively mature market.

Increase in LAS Prices Over Last Two Years

Higher oil has spurred a dramatic run-up in surfactant prices



Source: Gordon Graff, Petroleum, plant oils send surfactant prices through the roof. Purchasing, 1/17/2008, <http://www.purchasing.com/article/CA6518717.html>

The price gap has narrowed between synthetic surfactants and the traditionally cheaper natural ones, reducing the competitive edge natural surfactants once had over synthetic ones, especially in detergents, the largest end-use market for surfactants due to the heavy demand for plant oils in biodiesel products.

Renewable, Biobased Industrial Products fits into three major drivers in the marketplace:

- **To increase new uses and markets for agricultural commodities**
- **To improve the products' environmental footprint**
- **To reduce the use of petroleum-based products**

Feedstocks:

- **Identify the properties of crop oils that are desirable for industrial use and communicate with plant scientists**
- **Identify alternative, economical feedstocks**
- **Utilize animal waste and byproducts as bioproduct feedstocks**

Processing and Conversion:

- **Basic chemistry research (oils, proteins, carbohydrates, lignin, etc.)**
- **Economical green chemical processes (advances have been made, but not cost effective yet)**
- **Scalability (large-scale production of biobased products)**
- **Utilization of existing manufacturing plants (biodiesel plants are operating at 35-50% capacity)**

End Use Markets

- **Opportunities:**
 - **Short-term: to commercialize direct replacements for typically petroleum-derived products**
 - **Longer term: to develop new products with increased functionality and improved environmental properties**
- **Development of adhesives (soy based adhesives in non-structural panels has been successful)**
- **Biodegradable lubricants (demand is very strong in Europe and U.S. because of the regulatory standards)**
- **Developing end use applications of biobased polymers, plastics, composites, foam, and other materials**

End Use Markets

- **Developing new uses for bioproducts, such as synthetic fibers out of soy protein**
- **New possibilities mainly based on fibers include: geotextiles, filters, sorbents, structural composites, non-structural composites, molded products, packaging in combination with other resources**
- **Surfactants, personal care and laundry products**
- **Life cycle analysis should be performed to help identify best practices in all stages of development for biobased products (feedstock development to end-use and disposal/recycling)**

The BioPreferred Program

- **Managed by USDA, requires federal buyers and their contractors to give preference to qualified biobased products. The program was enacted as part of the 2002 Farm Bill.**
- **There are now a total of 2,741 products from 659 companies that may qualify for preferred procurement under the BioPreferred Program.**
- **To review the new BioPreferred Program or for more information visit: www.biopreferred.gov**

21st CENTURY MAY WELL BE KNOWN AS THE BIOBASED ERA



Thank You!

