How Much Would Agriculture Have To Adjust?

Meeting the Pyramid recommendations would mean significant changes for some parts of American agriculture. However, the aggregate change for the sector would be relatively small. A net increase of 5 to 6 million acres of cropland would be needed to meet the recommendations (table 3). This increase is relatively small in relation to total planted area—about 2 percent of total 1991-95 agricultural cropland—and below the almost 22 million acres of cropland idled under Federal annual acreage planting constraints during 1991-95.[5]

However, this modest 2-percent net adjustment masks larger changes in production and prices expected for some sectors—such as sweeteners, fats and oils, and fruits—which could be significant compared with recent changes these sectors have undergone. Also, since land and climate in the United States are not homogeneous, adjustments for some commodities may be concentrated in specific regions. For all sectors, adjustments in domestic demand will cause prices to change. This, in turn, will lead to changes in the type and quantity of food produced, and how and where it is produced.

Caloric Sweeteners

An unprecedented 60-percent reduction in the average consumption of caloric sweeteners would be necessary to reach the Pyramid suggested daily maximum of the equivalent of 12 daily teaspoonfuls. Such a reduction contrasts with the 9-percent per capita increase in caloric sweetener use between 1991 and 1995.

U.S. caloric sweetener consumption is divided almost evenly between cane and beet sugar (45 percent) and corn sweeteners (54 percent). *High-fructose corn sweetener* (HFCS) accounts for over 70 percent of corn sweeteners, with glucose and dextrose accounting for the remainder. Our analysis focuses on cane and beet sugar and on corn sweeteners.

Cane and Beet Sugar The United States is the fourth largest sugar producer in the world, and is one of the few countries that produces significant quantities of both sugar beets and sugarcane. Total sugar production (raw value) averaged 7.6 million tons annually in 1991-95—54 percent from sugar beets and 46 percent from sugarcane. Imports accounted for about 20 percent of total domestic sugar supplies (table 4).

Table 3—Maximum Acreage Adjustments Implied by Full Adoption of Food Guide Pyramid Serving Recommendations [1]

Crop	Average planted area, 1991-95	Adjustments in acreage
	Million acres	
Fruits[2]	3.4	--
Citrus	.9	1.4
Melons and berries	.6	.7
Other noncitrus	1.9	2.1
Vegetables[2]	4.5	--
Dark-green and deep-yellow vegetables	.4	1.4
Starchy vegetables	2.4	-.9
Other vegetables	1.6	- .5
Dry beans, peas, and lentils	2.1	2.7
Peanuts[3]	1.7	--
Tree nuts[3]	.7	--
Wheat[3]	70.7	--
Rice[3]	3.1	--
Feed grains:[2]	98.2 [4]	--
From sweeteners	5.6	-3.5
From oilseed production	0	2.0
From meat and dairy	55.7	5.0
Soybeans	60.5	-3.0 [5]
Sugar[2]	2.3	
Beet	1.4	-1.1
Cane	.9	-.7
Land used for food crops	247.1	5.6
Other cropland[6]	108.7	--
Total	355.8	5.6

-- = Minimal adjustment needed.
[1] Maximum estimate assumes that all adjustments occur in domestic production with no offsetting changes in trade or other uses.
[2] Acreage adjustments were calculated for subgroups only.
[3] Less than 0.1 million acres.
[4] Includes acreage used to produce grains for exports and other uses.
[5] Direct estimation of the impact on soyoil production implies a 12-million-acre decline. Demand for soymeal would limit the overall decline.
[6] Includes idled land plus land planted to cotton, hay, silage, and miscellaneous crops, but excludes the Conservation Reserve Program. Acreage adjustments were not calculated for these crops.
Source: USDA, Economic Research Service.

[5]Authority for these programs expired in 1996 with the passage of the 1996 Farm Act.

The 60-percent reduction in sugar consumption implied by the food supply servings estimates would cause prices and sweetener supplies to decline sharply. Such a drop in supply would likely be met through a combination of reduced domestic production and reduced imports (table 5).

Without offsetting increases in exports, nonfood uses, or imports, a 60-percent reduction in both domestic sugar production and imports would mean a 4.5-million-ton reduction in domestic sugar output. A decline in sugar consumption would also lead to a drop in sugar acreage of 0.7 million acres of sugarcane and 1.1 million acres of sugar beets, assuming no change in trade. Some adjustment in sugar imports would also likely occur. If the adjustments were borne proportionately between domestic production and imports, sugar imports would decline to under 1 million tons from a 2.1 million annual average during 1991-95. Domestic sugar acreage would decline by 0.6 million acres of sugarcane and 0.9 million acres of sugar beets (assuming proportionate reductions in cane and beet sugar production).

Adjustments in the sugar sector would be complicated by U.S. sugar legislation under the *Federal Agriculture Improvement and Reform Act of 1996 (1996 Farm Act)*. Sugar is produced domestically under a system of price supports and import restrictions, or tariff-rate quotas (TRQ's), administered by the U.S. Department of Agriculture (Lord). Under the raw sugar TRQ, quota-holding countries are allocated a fixed amount of sugar that they may ship to the United States each year at no or low duty. For any sugar entering the United States above the quota, a duty is imposed, which is generally high enough to prevent imports above the quota amount. The TRQ is established annually (and sometimes adjusted in a given year) to control supply, and it is set to fill the gap between forecasted domestic consumption and production.

The TRQ acts as a price support only as long as the gap between U.S. sugar consumption and production remains above 1.5 million tons. Were domestic consumption to fall by the full 60-percent implied by the Pyramid recommendations, the TRQ likely would drop below 1.5 million tons, resulting in a suspension of the price-support program under the provisions of the 1996 Farm Act. With the price-support program suspended, farm-level sugar prices would fall to world levels, and production and imports would adjust downward to balance the domestic market.

Any reduction in domestic sugar production would imply shifts in the land, water, and other resources currently used to produce sugarcane and sugar beets.

While we made the simplifying assumption that reductions in sugar output will come proportionately from cane and beet production, economic theory suggests that reductions in output will also occur in areas where marginal costs are highest. Cane producers may bear the brunt of any reductions in sugar demand, because they receive lower returns and yield less sugar per acre than beet growers.

U.S. sugarcane production and processing are concentrated in southern Florida and Louisiana, but Hawaii and Texas are also important growing regions (fig. 3). Sugar beets are grown across a fairly wide geographic

Table 4—The Sweetener Sector, 1991-95

Production (million tons):	
Cane and beet sugar (raw value)	7.6
Corn sweeteners (dry weight)	10.8
Corn for corn sweeteners (million bushels)	660
Imports:	
Cane and beet sugar (raw value)	2.1
Corn sweeteners (dry weight)	.2
Exports:	
Cane and beet sugar (raw value)	.7
Corn sweeteners (dry weight)	.3
Harvested acres:	
Sugarcane (million acres)	.9
Sugar beets (million acres)	1.4
Corn for corn sweeteners (million acres)	5.5

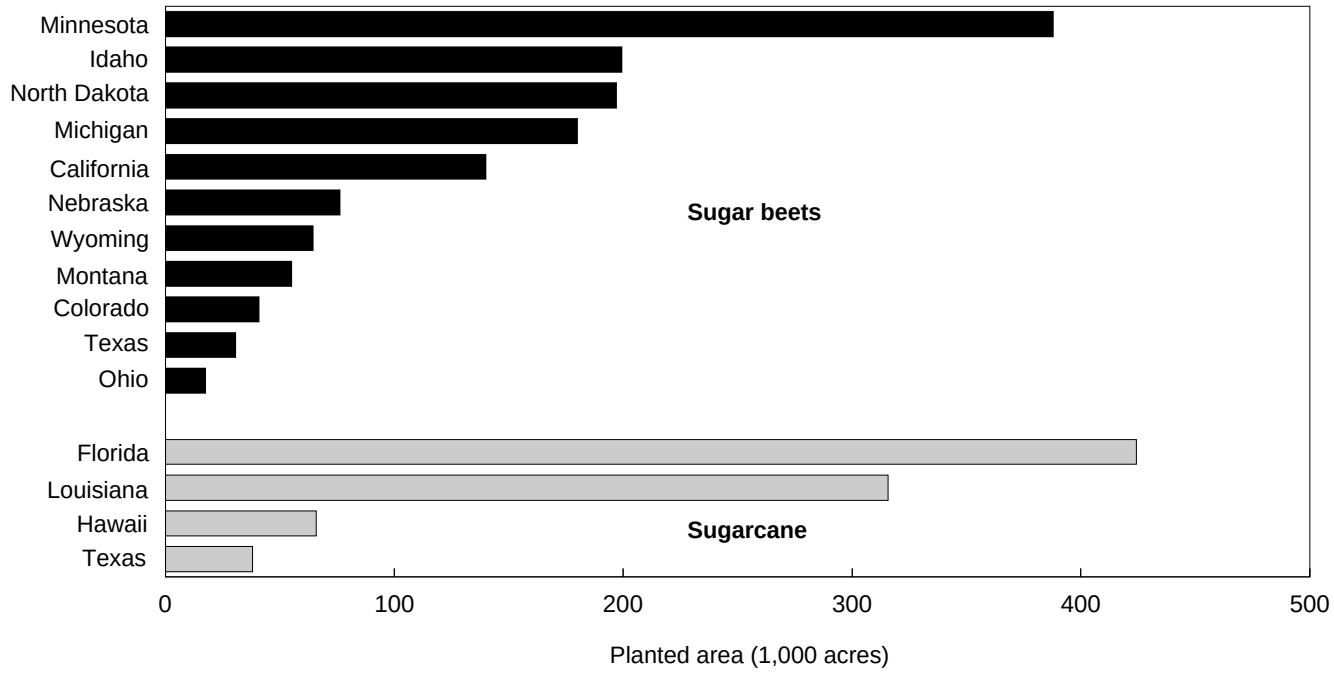
Source: Lord, 1996.

Table 5—Caloric Sweeteners: Projected Changes in Supply, Demand, and Prices Implied by Pyramid Serving Recommendations

Item	Cane and beet sugar	Corn sweeteners
Supply components:		
Domestic production	↓	↓
Imports	↓	*
Demand components:		
Food use	↓	↓
Exports	*	*
Industrial use	*	*
Prices	↓	↓

*These uses are relatively small and were not evaluated.
Source: USDA, Economic Research Service.

Figure 3
Most Sugarcane and Sugar Beets Are Produced in a Small Number of States



Source: USDA, Economic Research Service.

area, with the Red River Valley of Minnesota and North Dakota, and regions in Idaho, Michigan, and California major sugar beet regions. In Hawaii, areas allocated for sugarcane production compete with profitable alternative land uses, such as hotel, recreation, and other tourism-related industries. A switch to these alternative uses could accelerate and absorb losses caused by a declining sugar demand. Much of Florida's sugarcane area would be well suited for production of fruits and vegetables, demand for which would increase under the Pyramid dietary recommendations.

However, the full extent of any switch of sugarcane cropland to alternative uses, such as citrus fruits and winter vegetables, likely would be determined in large part by changes in relative prices and environmental concerns. Agricultural activity—notably sugarcane production—in south Florida has been identified as a contributor to the decline of the Everglades ecosystem. The 1996 Farm Act provides funding for land acquisition in the Everglades region to aid in the restoration of the region's natural habitat (Aillery and others, 1997).

The impact of reduced sugar beet production would be spread across a large and diverse geographic area. The initial cuts in production likely would come in regions that can profit from switching to alternative crops. In recent years, sugar beet acreage decreased in the more marginal production areas of California, Michigan, Ohio, and some Western and Northern Plain States, and production has been well below processing capacity (Lord, 1997). However, due to the magnitude of the projected reductions, major producing areas in the Northern Plains would face production adjustments. Most sugar beet regions would be well suited to production of pulses (dry beans, peas, and lentils) and cool-weather, seasonal, dark-green and deep-yellow vegetables (see "Vegetables" section, page 12).

Corn Sweeteners Corn sweeteners, primarily HFCS, account for a significant and growing share of the U.S. caloric sweetener market. In the 1980's, the sugar price-support program and technological advances caused sugar prices to rise, making the conversion of corn starch to a fructose syrup sweetener more economically viable. Since then, average consumption of HFCS has increased by more than 60 percent (Moore and Buzzanell, 1991). HFCS is now the sweetener of choice in the U.S. soft drink industry, which accounted for 73 percent of total HFCS use in 1993-95. Because HFCS prices are lower than sugar

prices, it has increasingly replaced sugar in other processed foods, such as ketchup, breakfast cereals, and frozen dairy desserts.

The United States imports small quantities of corn sweeteners. Any reduction in domestic demand for HFCS and other corn sweeteners thus would cause adjustments in domestic production and/or exports. Assuming that demand for HFCS declines by the same 60 percent as the demand for sugar, adjustments in the corn sweetener sector would include a 6.5-million-ton decline in domestic corn sweetener production. That equates to a 400-million-bushel, or 3.5-million-acre, reduction in demand for field corn used to produce sweeteners (see also the "Grains" section, page 20).

Such a reduction in corn sweetener production would also imply sizable adjustments on the part of the wet-milling industry that produces corn sweeteners. The projected reduction contrasts sharply with the 25-percent expansion in U.S. wet-corn milling capacity that occurred between 1994 and 1996 (Lord, 1997). Reduced corn sweetener output would sharply reduce the availability of corn gluten meal and other byproducts of the wet-milling process. (These byproducts are mostly exported to Europe as livestock feed.)

Some of these adjustments may be mitigated by higher exports of corn sweeteners. However, the United States exported less than 3 percent of HFCS output in 1991-95 (most of it went to Mexico and Canada). Thus the ability of the export market to absorb a significant share of the surplus HFCS production may be limited—at least in the short term.

Fats and Oils

U.S. per capita consumption of added fats and oils (shortening, salad and cooking oils, lard, and edible tallow) and dairy fats (butter, sour cream, fluid cream, and cream cheese) is among the highest in the world. In 1995, average consumption, after adjusting for waste and spoilage, was 59 fat grams per person per day. These fats are consumed in addition to those that naturally occur (such as in meats, dairy products, and nuts), which were not directly measured.

Adjustments in the added fats and oils sector are the most complex that the agricultural sector would face if it were to parallel the Food Guide Pyramid. Reducing total fat intake to the suggested upper limit of 30 percent of calories would imply a sharp reduction in the consumption of both added edible fats and oils as well as naturally occurring fats. This section reports adjustments in the added fats and oils market (adjustments in naturally occurring fats are considered in the "Meat, Poultry, and Fish" and "Dairy" sections). To meet suggested dietary limits for total fat intake, average consumption of edible fats would need to decline by an estimated 36 percent.[6] Such a reduction would

[6]According to food supply nutrient data for 1994, added fats and oils accounted for 52 percent of the total fat (grams) provided by the food supply. Assuming that added edible fats and oils continue to account for about the same share of total daily fat grams, the quantity of added fats and oils would have to decline by 36 percent to bring consumption of added fats to 38 grams (73 grams of total fat multiplied by 0.52 equals 38 grams of added fats and oils). That would bring total fat grams close to the recommended upper limit of 30 percent of calories for a 2,200-calorie diet.

Table 6—Added Fats and Oils: Projected Changes in Supply, Demand, and Prices Implied by Pyramid Serving Recommendations

Item	Soybeans	Soybean oil	Soybean meal	Other fats and oils
Supply components:				
Domestic production	↓	↓	↓	↓
Imports	*	*	↑	*
Demand components:				
Food use [1]	*	↓	*	↓
Exports	↑	↑	↓	↑
Industrial use	↑	↑	*	↑
Prices	↓	↓	↑	↓

*These uses are relatively small and were not evaluated.
[1] Soybeans and soybean meal are used mainly for animal feed.
Source: USDA, Economic Research Service.

contrast sharply with the 0.5-percent increase in per capita consumption of these fats between 1991 and 1995.

Reductions in edible fat and oil consumption will have the largest impact on the soybean sector and its related industries (table 6) since soybean oil dominates the U.S. added fats and oils market (table 7). The major U.S. soybean-producing regions are the Midwestern and Delta States (fig. 4).

Soybean Oil Because most soybean oil consumed in the United States is produced domestically, a 36-percent reduction in domestic soyoil demand would disrupt the soybean market severely. Without offsetting market adjustments, soyoil production would need to decline by 2 million tons in order to match the reduced domestic demand. Soybean acreage would then have to decrease 20 percent, or 12 million acres, to a level comparable with the early 1970's (48 million acres).

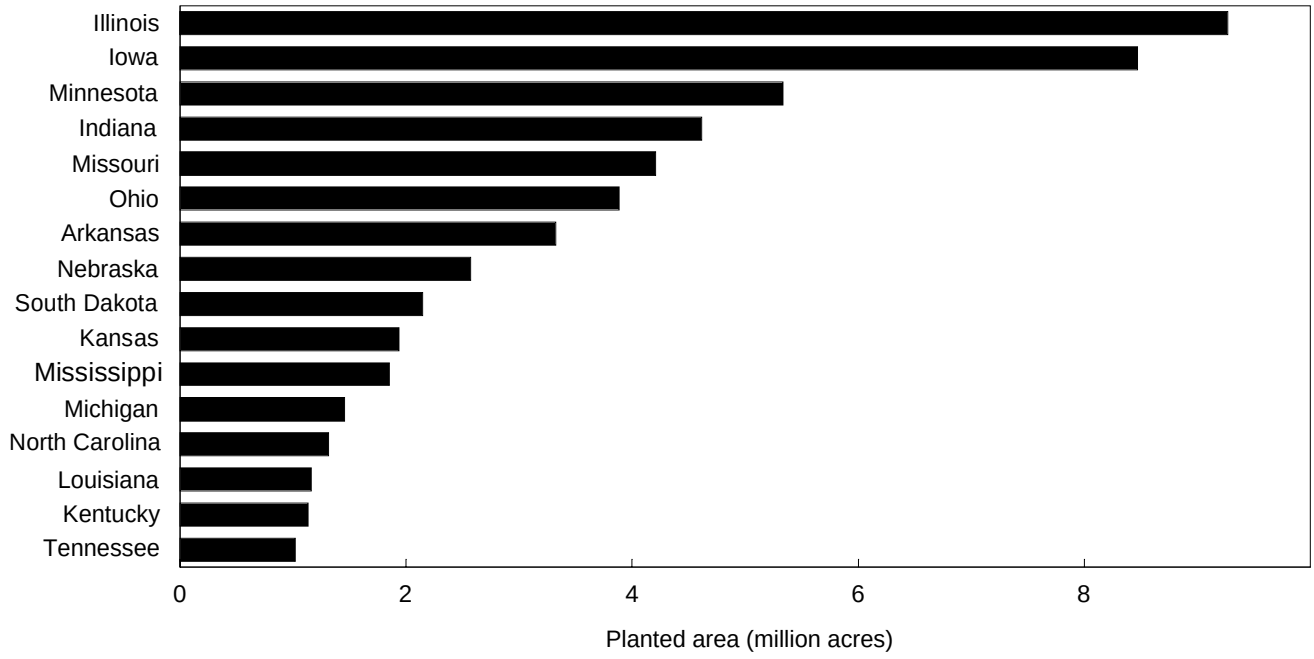
However, a reduction of this magnitude is not likely to occur. Market forces likely would limit the reduction in soybean production to less than 3 million acres. For example, reducing soyoil production would be complicated by the fact that the same soybeans that are crushed for soyoil also yield soybean meal, a high-protein animal feed particularly important to poultry and hog production. Soybean meal typically accounts for more than half the value of processed soybeans.

Table 7—The Soybean Sector, 1991-95

Production:	
Soybeans (million bushels)	2,148
Soybean oil (million tons)	7.3
Soybean meal (million tons)	31.3
Exports:	
Soybeans (million bushels)	746
Soybean oil (million tons)	.8
Soybean meal (million tons)	6.2
Planted area:	
Soybeans (million acres)	60.6
Soyoil's share of added fat and oil supplies:	
Baking or frying fats (percent)	79
Margarine (percent)	93
Salad or cooking oil (percent)	82
Other added fats (percent)	40
Total added fats and oils (percent)	81

Source: Sanford, 1996.

Figure 4
Midwestern States Are Major Soybean Producers



Source: USDA, Economic Research Service.

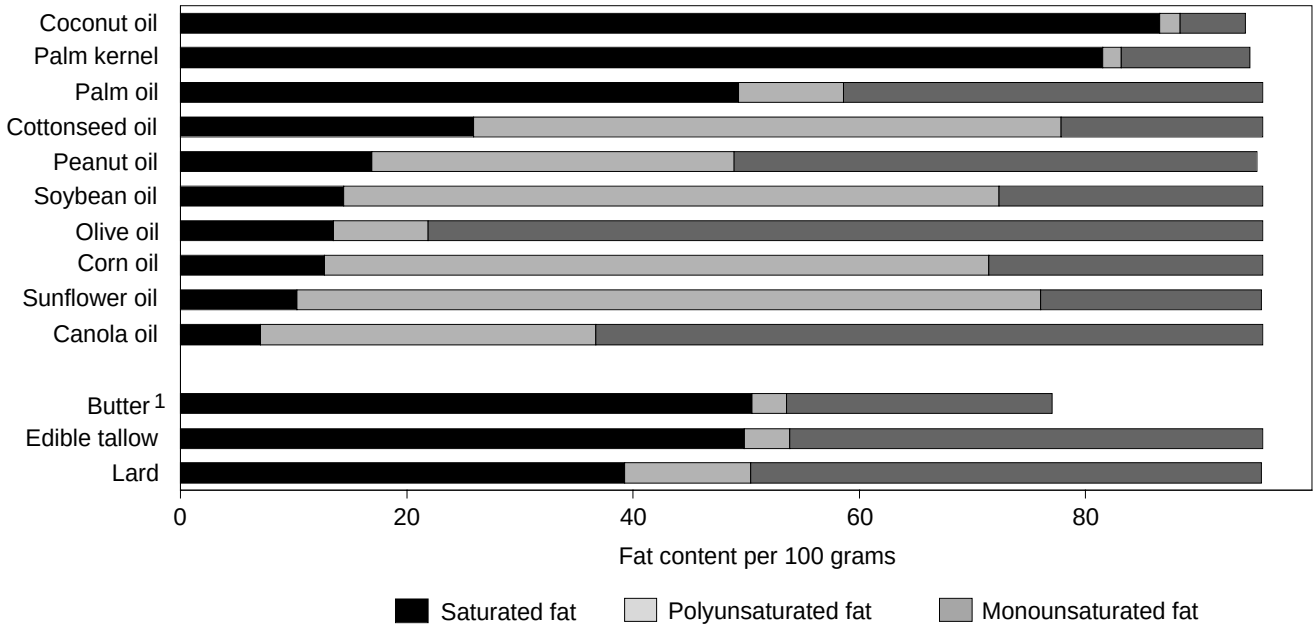
Lower soyoil prices could cause a reduction of soybean acreage. However, any reduction could be offset by the livestock industry, which would bid up soymeal prices in an attempt to maintain supplies of high-protein feeds. In addition, the relatively higher meal prices would encourage farmers to shift to alternative soybean varieties that have a higher meal-to-oil content. As soyoil prices decline, alternative uses for soyoil, like biofuel, may also become profitable. This in turn, would limit price declines for soyoil and acreage declines for soybeans.

Increasing soyoil exports by the entire 2 million tons of surplus oil generated by changing diets would more than double current U.S. soyoil exports from the 1991-95 average of less than 0.8 million tons. With total world soyoil trade at about 5 million tons in 1991-95, exports of this magnitude would affect the world market. World soyoil prices would decline, and make soyoil even more competitive with other fats and oils. The U.S. share of the world soyoil market has declined dramatically over the past 30 years. Presumably, lower soyoil prices would make U.S. producers more competitive on world markets and might help recapture a portion of lost market shares.

Other Fats and Oils The use and prices of other fats and oils would decline substantially to meet the Pyramid dietary recommendations. A reduction or elimination of imports—which would mostly affect supplies of tropical oils (palm, coconut, and others), olive oil, and canola oils—could reduce adjustment pressures on the domestic fats and oils sector. Reducing imports of tropical oils, which are relatively high in saturated fat, may improve the nutrient profile of supplies of added oils (fig. 5). However, reducing or eliminating imports of olive and canola oils contrasts with current trends. Widespread publicity surrounding the health benefits of those oils has helped to more than double consumption over the past 10 years.

Surpluses of both soybean oil and other domestically produced fats and oils also could be diverted to industrial uses. Animal and vegetable fats are used in a wide variety of industrial applications, including printing inks, soaps, cosmetics, lubricants, paints and varnishes, solvents, resins, plastics, and fuel additives. Although less than 3 percent of total edible fats and oils were used in industrial applications in 1991-95 (Sanford, 1996), the lower oil prices that would result

Figure 5
Nutrient Profile of Edible Fats and Oils Differs by Product



[1]In addition to fat, butter contains water, protein, and carbohydrates.
Source: USDA, ARS, Nutrient Data Laboratory, 1998.

from a large reduction in food consumption of fats and oils could expand industrial uses.

Vegetables

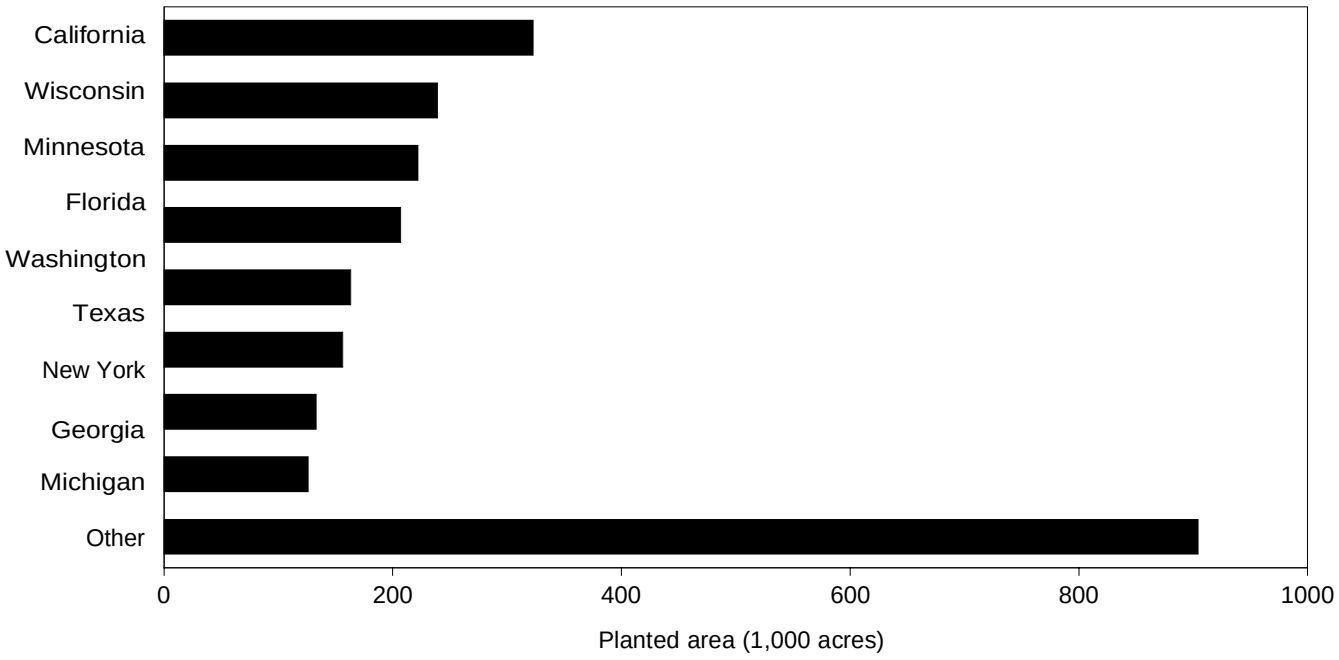
Increasing per capita vegetable consumption to meet the minimum Pyramid serving recommendation for a 2,200-calorie diet would require adjustments in both the quantities and types of vegetables supplied to the U.S. marketplace. Larger changes would take place for certain commodity subgroups—notably dry beans, peas, and lentils, and dark-green leafy and deep-yellow vegetables—than for others.

The net increase in average vegetable consumption needed to meet the Pyramid recommendations is less than 10 percent. However, average diets would include more than four times as many dark-green leafy and deep-yellow vegetables, three times as many dry beans, peas, and lentils, and fewer servings of starchy (mostly potatoes) and other vegetables. These changes differ considerably from consumption trends for these food groups during 1991-95.

A net increase of 2-3 million acres of vegetables would be needed to produce the additional 9 billion pounds (farm weight) of vegetables that would be needed to provide all Americans with four average daily servings of vegetables recommended by the Food Guide Pyramid. This net change would include a 1.5-million-acre expansion in harvested acreage of dark-green leafy and deep-yellow vegetables, a 2.7-million-acre expansion of legume (dry beans, peas, and lentils) acreage, and as much as a 1.5-million-acre reduction in harvested acreage of starchy and other vegetables. Significant price adjustments would be needed to draw land from other crops and to induce these land use adjustments. Labor and other resource constraints could also be problematic as producers shift from relatively low-labor crops like potatoes, to more perishable commodities, like lettuce and other dark-green leafy vegetables, which generally require additional labor and handling during harvest and marketing.

Although some U.S. regions, such as California, have distinct climate and soil advantages, vegetables are grown in a variety of locations (fig. 6). The anticipated adjustments could be spread across a wide geographic region. Some of the increase in domestic supplies might be achieved by switching the types of crops produced in existing agricultural areas. For example, the sugar beet area in the Upper Midwest and Pacific Northwest is well suited for production of

Figure 6
Vegetables Are Grown in Most States, But California Leads Production



Source: USDA, Economic Research Service.

legumes and cool season dark-green leafy and deep-yellow vegetables (the Northwest is already a major legume producer). In addition, some sugarcane areas in south Florida could accommodate production of tender season vegetables during the winter months.

Areas that produce soybeans could also be converted to vegetable production. Vegetable production might also take over land previously used for corn sweetener production. However, provisions of the 1996 Farm Act that restrict planting of fruits and vegetables on acreage enrolled in commodity income-support programs (*contract acreage*) would limit such an expansion onto contract land (until at least 2002). Depending on market conditions, shifts of soybean and corn area to vegetable production may also be curbed by higher feed grain prices from expanded production of lowfat dairy products, poultry, and lean meats (see also the "Meat, Poultry, Fish, Dry Beans, Eggs, and "Nuts" and "Grains" sections, pages 18 and 20).

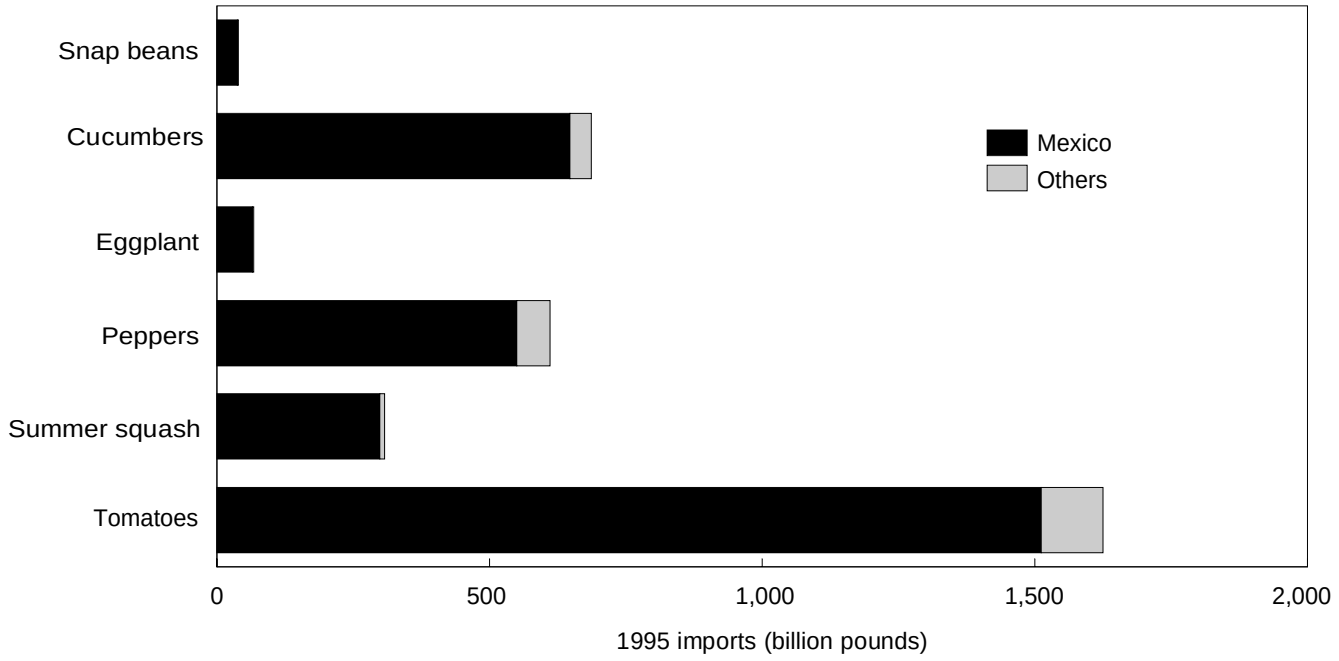
Trade adjustments could also boost domestic supplies of vegetables, particularly fresh winter vegetables. Mexico is already the main import supplier of fresh winter vegetables for the United States (fig. 7), and low-cost imports likely would capture at least a portion of the increased vegetable consumption

Table 8—The Vegetable Sector, 1992-95[1]

	Million pounds
Production:	
Dark-green leafy and deep-yellow vegetables	11,830
Dry beans, peas, and lentils	3,125
Potatoes and starchy vegetables	53,880
Other vegetables	49,750
Imports:	
Dark-green leafy and deep-yellow vegetables	570
Dry beans, peas, and lentils	145
Potatoes and starchy vegetables	1,050
Other vegetables	3,840
Exports:	
Dark-green leafy and deep-yellow vegetables	450
Dry beans, peas, and lentils	1,150
Potatoes and starchy vegetables	2,600
Other vegetables	3,950
	1,000 acres
Harvested area:	
Dark-green leafy and deep-yellow vegetables	430
Dry beans, peas, and lentils	2,100
Potatoes and starchy vegetables	2,400
Other vegetables	1,630

[1] Comprehensive data are not available for 1991.
Source: Lucier, 1996.

Figure 7
Mexico Is The Main Import Source of Fresh Winter Season Vegetables in the U.S. Market



Source: USDA, Economic Research Service.

Table 9—Vegetables: Projected Changes in Supply, Demand, and Prices Implied by Pyramid Serving Recommendations

Item	Dark-green leafy and deep-yellow vegetables	Dry beans, peas, and lentils	Starchy vegetables	Other vegetables
Supply components:				
Domestic production	↑	↑	↓	↓
Imports	↑	*	*	*
Demand components:				
Food use	↑	↑	↓	↓
Exports	*	↓	*	*
Industrial use	*	*	*	*
Prices	↑	↑	↓	↓

*These uses are relatively small and the impacts were not evaluated.
Source: USDA, Economic Research Service.

(O'Brien, 1995). More U.S. producers would probably invest in Mexican operations as a way of meeting the U.S. demand.

At the same time, additional supplies would become available as higher vegetable prices would divert current vegetable exports to the domestic market. In 1992-95, the United States exported approximately 7.5 billion pounds (farm weight) of fresh, processed, and frozen vegetables, excluding dry beans, peas, and lentils. In addition, more than one-quarter of dry bean production and over half of dry pea and lentil output were exported in 1992-95, primarily to Canada, suggesting that the United States already has the production capacity to meet at least a portion of the required increase in legume supplies. However, the adjustment process would be complicated by the close integration of the U.S. and Canadian markets and the dependence of the Canadian market on U.S. vegetables; approximately 60 percent of Canadian vegetable imports come from the United States. Prices in Canadian markets would rise as consumers reacted to any supply reduction resulting from reduced imports from the United States.

Table 10—The Fruit Sector, 1991-95

	Million pounds
Production:	
Citrus fruits	27,750
Melons and berries	7,650
Other fruits	33,300
Imports:	
Citrus fruits	400
Melons and berries	1,200
Other fruits	10,300
Fruit juice (million gallons, single-strength equivalent)	540
Exports:	
Citrus fruits	2,600
Melons and berries	600
Other fruits	2,570
Fruit juice (million gallons, single-strength equivalent)	180
	1,000 acres
Harvested acres:	
Citrus fruits	940
Melons and berries	480
Other fruits	1,880

Source: Calvin, 1996.

Fruits

Fruit consumption for a 2,200-calorie diet would more than double if the average U.S. diet were to meet the Pyramid serving recommendations. Consumption of citrus, melons, and berries would need to increase by 150 percent, and supplies of "other fruits" would need to increase by 114 percent. These targets contrast sharply with recent trends, with total fruit consumption (excluding wine grapes) increasing only 5 percent between 1981-85 and 1991-95.

Increased fruit demand would cause fruit prices to rise and, in turn, increase domestic fruit production and imports (table 11). Meeting the projected consumption increase with domestic production alone would imply

a 3- to 4-million-acre increase in total fruit area and would require lead times of 3-5 years for the trees to begin bearing fruits. Additional production may also be limited by the availability of labor as producers shift from less labor-intensive crops, like *oilseeds*, corn, or sugar beets.

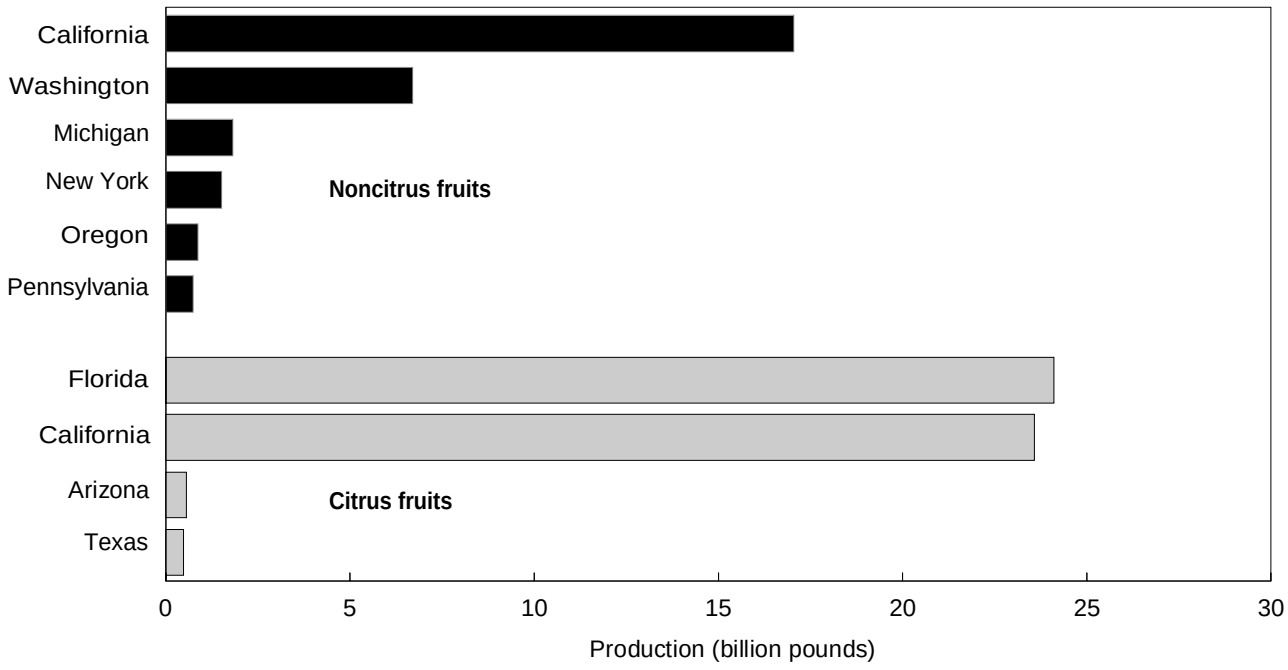
Citrus, Melons, and Berries To meet the Pyramid standards, consumers would have to increase their intake of citrus fruits, melons, and berries. An increase in melon and berry production by 0.5 to 0.75 million acres could occur quickly. However, domestic expansion would be more difficult for citrus crops. U.S. citrus production is limited by environmental constraints, such as susceptibility to freezes, and to extreme southern locations of Florida, California, Arizona, and Texas (fig. 8). Sufficient land in these regions may not be available to support the required expansion in citrus area, regardless of any price increase. Some area currently devoted to sugarcane in

Table 11—Fruits: Projected Changes in Supply, Demand, and Prices Implied by Pyramid Serving Recommendations

Item	Citrus fruits	Melons and berries	Other fruits
Supply components:			
Domestic production	↑	↑	↑
Imports	↑	↑	↑
Demand components:			
Food use	↑	↑	↑
Exports	↓	↓	↓
Industrial use	*	*	*
Prices	↑	↑	↑

*These uses are relatively small and the impacts were not evaluated.
Source: USDA, Economic Research Service.

Figure 8
Four States Lead Fruit Production in the United States



Source: USDA, Economic Research Service.

Texas and southern Florida could potentially be shifted to citrus production, although total sugarcane area in these two States would provide less than half of the land needed to boost citrus production. And, additional citrus production in California and Arizona may be limited by water availability.

Other Fruits Increasing supplies of other fruit would be less constrained by climatic concerns, because production of these fruits is scattered more widely throughout the country. Any price increase would induce increases in domestic production. Sugar beet area in Michigan and Ohio would be well suited for additional production of apples, cherries, and grapes, which are already grown in these regions. Land planted to soybeans could also be appropriate for fruit production.

Pears, peaches, and plums could be grown in sugarcane areas of Louisiana and Texas. However, like citrus fruits, long lead times would be needed for new trees to begin bearing fruits. Also, high transportation costs and pest problems in Hawaii and water constraints in California and Arizona may limit expansion in these areas. In addition, labor constraints could be encountered in all markets.

Trade Implications Given the land, labor, and climate constraints that may limit expanded fruit production in the United States (and the time lag associated with expanding fruit production), trade adjustments would likely play an important role in meeting increased consumer demand for fruits. The United States imported about 28 percent of total fruit supplies, including juices, in 1991-95. Brazil is the most likely supplier of additional citrus imports. However, citrus imports currently are limited by high tariffs. If higher prices in the U.S. market are combined with lower tariffs, imports from countries such as Brazil could increase. Trade agreements, such as the *North American Free Trade Agreement (NAFTA)* and the *Uruguay Round Agreement*, will be particularly important in limiting price increases as lower trade barriers increase the availability and affordability of fruit imports.

Higher domestic fruit prices could also divert fruits to the domestic market that are currently exported by U.S. producers. In 1991-95, approximately 5.8 billion pounds of fruits and fruit juices (fresh-weight equivalent) were exported. Diverting that amount to domestic consumption would help close the gap between actual and needed supplies. As with vegetables, any significant reduction in exports would create a price increase in export markets, particularly in Canada and in Japan (which would tend to reverse some of the initial reduction in exports).

Milk, Yogurt, and Cheese

Dairy product consumption would need to grow by 22 percent in order for average diets to meet the Pyramid serving recommendations for the milk, yogurt, and cheese group. However, most of the growth likely would come from reduced-fat or nonfat versions of existing dairy foods, as consumers turn away from regular dairy products that are naturally high in fat, saturated fat, and cholesterol.

Table 12—The Dairy Sector, 1991-95

	Million pounds
Production	151,600
Imports	2,750
Exports	5,670
Milk products:	
American cheese	2,950
Other cheese	3,590
Nonfat dry milk	1,030
Butter	1,320

Source: USDA, Economic Research Service, March 1997a.

Table 13—Dairy: Projected Changes in Supply, Demand, and Prices Implied by Pyramid Serving Recommendations

Item	Lowfat milk products	Dairy fats
Supply components:		
Domestic production	↑	↓
Imports	↑	*
Demand components:		
Food use	↑	↓
Exports	*	↑
Industrial use	*	↑
Prices	↑	↓

*These uses are relatively small, and the impacts were not evaluated.
Source: USDA, Economic Research Service.

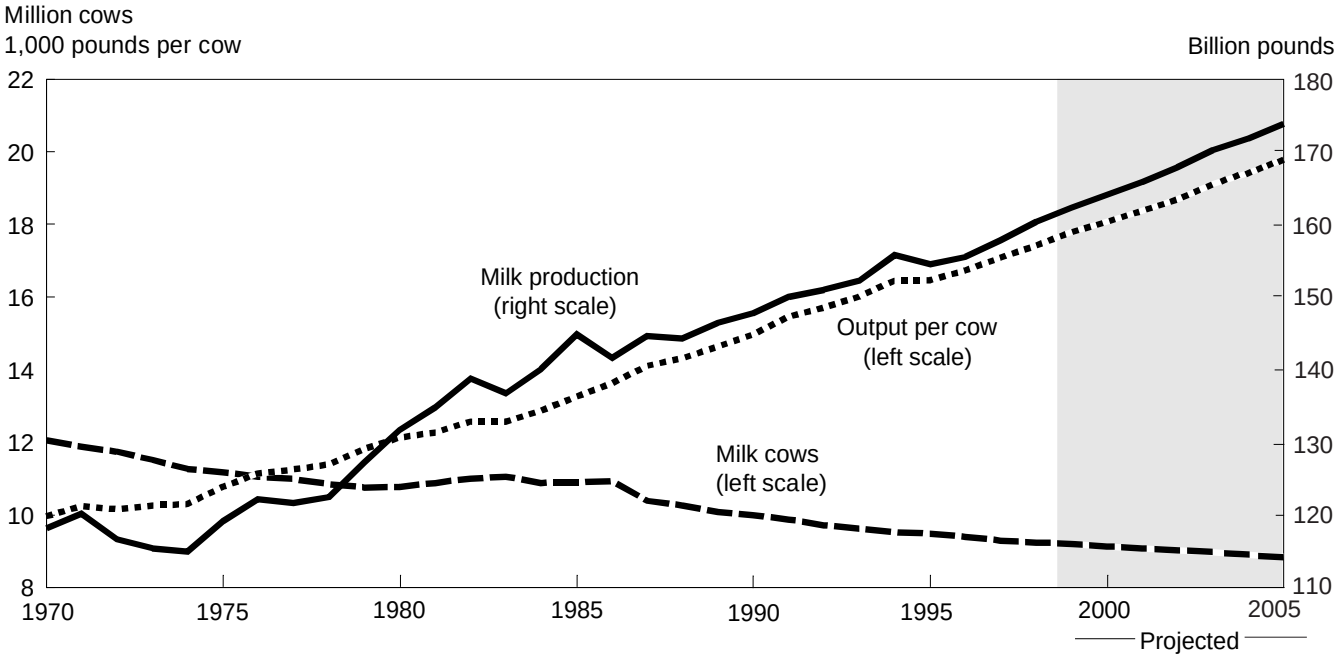
With the exception of certain imported cheeses, the United States produces nearly all of its own dairy products. The United States exported less than 5 percent of total dairy production (milkfat, milk-equivalent basis) during 1991-95 (table 12). Therefore, most of the increase in dairy supplies could be expected to come from U.S. farms.

Milk production has grown about 8 percent over the past 10 years. Even though the number of cows decreased by 15 percent, output per cow rose nearly 17 percent (fig. 9). Milk yield per cow is projected to grow 20 percent between 1995 and 2005 (Westcott, 1997). The projected increase in milk production per cow, combined with a 5- to 10- percent increase in the size of the U.S. dairy herd over 1991-95 levels (Westcott, 1997), would provide a sufficient increase in raw milk supplies to meet the Pyramid targets for dairy consumption. Additional supplies of milk could be made available by reducing production of high-fat products, such as butter or sour cream. However, the skimmed milkfats would need to be diverted to other uses.

The projected increase in herd size would imply an increased demand for feed in the form of pasture, hay, feedgrains, soymeal, and other protein feeds, which would tend to increase demand and prices for these products. Sufficient land is available for expanding pasture and hay production. However, dairy farms tend to be located close to population centers, because milk is bulky and highly perishable. As a result, the supply of pastureland could be limited in some regions.

Increased demand for lowfat dairy foods in the United States may cause a portion of the surplus milkfat to end up on the export market, either in the form of butter or cheese, or alone as an ingredient for other food products. The United States is not a major exporter of dairy products. However, a substantial fall in domestic prices for milkfats would create export opportunities. To improve these opportunities and to support domestic prices, producers likely would seek increases in export-support programs, such as the *Dairy Export Incentive Program (DEIP)*. However, the extent to which such programs can be expanded is limited by budget constraints and existing trade agreements. For example, under the 1994 Uruguay Round Agreement, the United States cannot expand funding for DEIP beyond the agreed levels, which are already being met. However, despite these limits, the value of milkfats is likely to decline to levels that would make them competitive on world markets without any subsidies.

Figure 9
Milk Production Continues To Increase While Herd Size Declines



Source: Westcott, 1997.

As the price of dairy fats declines, alternative industrial uses for butterfat would become profitable. If dairy fats entered the industrial market, competition with other fats and oils could become more intense (see "Fats and Oils" discussion, page 9). If prices became low enough, dairy fats could also become a viable ingredient in livestock feed.

Meat, Poultry, Fish, Dry Beans, Eggs, and Nuts

Meeting the Pyramid serving recommendations for the meat group (meat, poultry, fish, dry beans, and nuts group)[7] would require adjustments in both the quantity and composition of protein foods currently supplied to the U.S. marketplace. Specific commodity shifts are difficult to quantify, because the Pyramid does not make serving recommendations for individual foods within the meat group. However, the consumption of lean foods is emphasized.

For a 2,200-calorie diet, the Pyramid recommends that each person consume on average about 6 ounces of cooked lean meat, with all visible fat removed. This serving can also come from other foods in this group—1 egg, 2 tablespoons of peanut butter, or 1/3 cup of nuts are counted as equivalent to 1 ounce of cooked lean meat.

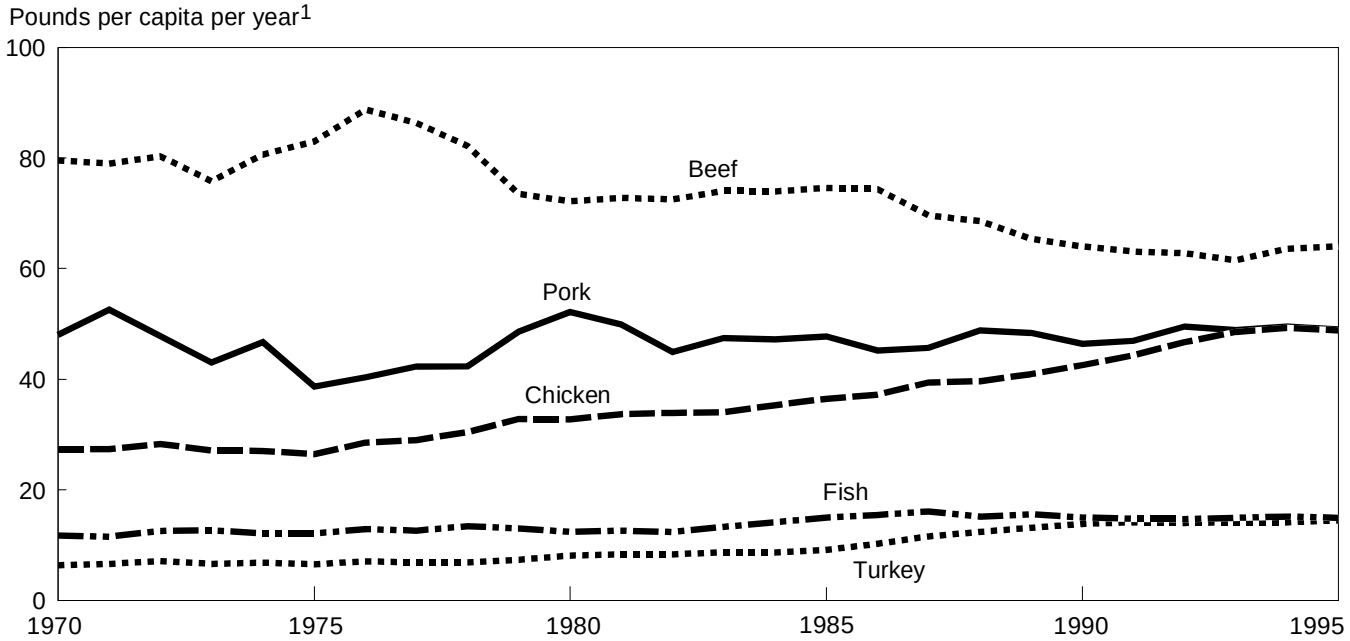
Meat, Poultry, and Fish The Food Guide Pyramid emphasizes lean meat products. And if consumers continue recent consumption patterns, they will meet the suggested 5-percent increase in servings from the meat group.

Consumers have become increasingly concerned about saturated fat and cholesterol since the 1980's. Consumer concerns, as well as shifts in relative meat prices, have reduced consumption of beef relative to pork and poultry and increased demand for lower fat meat products of all types (fig. 10).

As diets shift toward the Pyramid recommendations, poultry production likely will continue to increase its market share, while the cattle and hog sectors likely will build on existing breeding and management techniques that have already reduced the fat content of their products. For example, meat processors and packers have created lower fat products at the meat counter by trimming meat closer. Retail beef and pork cuts now have roughly 30 percent less trimmable fat than in the 1980's (Putnam and Duewer, 1995).

[7]Dry beans, peas, and lentils can be counted in either the meat or vegetable group. For consistency with other dietary assessments, these foods were counted in the vegetable group in this study.

Figure 10
Beef Is Still America's Most Popular Meat, But Chicken Is Gaining



[1]Boneless, trimmed-weight equivalent.
Source: USDA, Economic Research Service.

Table 14—The Meat Sector, 1991-95

	Million pounds
Beef[1]:	
Production	23,600
Imports	2,300
Exports	1,400
Pork[1]:	
Production	17,100
Imports	700
Exports	500
Poultry[1]:	
Production	27,500
Imports	0
Exports	2,600
Total red meat and poultry[1]:	
Production	68,900
Imports	3,100
Exports	4,500
Fish and shellfish[2]:	
Production	3,260
Imports	2,150
Exports	1,560

[1] Carcass weight.

[2] Edible meat weight.

Source: USDA, Economic Research Service, March 1997b.

Table 15—Meat, Poultry, Fish, Dry Beans, Eggs, and Nuts: Projected Changes in Supply, Demand, and Prices Implied by Pyramid Serving Recommendations

Item	Lean meats, poultry, and fish	Animal fats
Supply components:		
Domestic production	↑	↓
Imports	↑	*
Demand components:		
Food use	↑	↓
Exports	↓	↑
Industrial use	*	↑
Prices	↑	↓

*These uses are relatively small, and the impacts were not evaluated.

Source: USDA, Economic Research Service.

Increased demand for lean meats would raise retail prices for these cuts, while higher fat products would move to pet food, industrial uses, or export markets. Such a shift would have a measurable effect on the grain sector. More than a third of U.S. grain production is used domestically for animal feed. Higher demand for lean meats would raise the number of animals needed to produce a pound of meat, implying an equivalent increase in the demand for feed grains and high-protein supplements like soymeal. The magnitude of this adjustment would depend largely on the mix of products in the new supplies. Poultry production uses roughly half the feedgrains and oilseeds per pound of meat produced as pork production uses, and a quarter of the feedstuffs required to produce beef (O'Brien, 1995). Substantial increases in poultry consumption relative to beef or pork could reduce the size of the adjustments on the grain and soybean sectors (see "Grains" discussion, page 20).

Changes in meat trade could help ease the adjustments faced by domestic agriculture.

An increased demand for lean meats would cause surpluses of fatty meat parts, such as organ meats, chicken legs, and meat trimmings, which could be exported. Rising incomes in other countries have increased exports of these types of meat products in recent years to Asia, Russia, and Mexico. However, economic difficulties in Asia and Russia in 1998 slowed export demand in these markets.

Dry Beans, Eggs, and Nuts Other sectors in the meat group will likely not be significantly affected as diets move toward the Pyramid serving recommendations. Peanuts, tree nuts, and eggs together provided about 12 percent of servings from the meat group in 1991-95. If consumers reduced nut consumption (especially in the form of peanut butter) as a means of reducing fat intake, nut acreage (especially for peanuts) would decrease. However, such a consumption change would not have a measurable impact on total food production, since tree nuts and peanuts accounted for only 3 percent of total meat group servings and provided less than 4 percent of the total dietary fat available in the food supply in 1994. (Dry beans, peas, and lentils, and soy products are discussed in the "Vegetables" and "Fats and Oils" sections on pages 12 and 9.)

Eggs will likely remain a steady but small share of total meat group servings, continuing the pattern established since 1990. Processed egg products may continue to account for a growing share of total egg consumption. Many processed egg products provide all of the protein contained in a regular shell egg, but they contain little cholesterol or saturated fat because

they are made mostly with egg whites. Egg yolks are largely recovered for pet food and other uses.

Grains

Average servings for the grain group already meet the minimum Pyramid recommendations. As a result, changes in food grain use, such as for flour, pasta, and rice, will be relatively minor, resulting mainly from increased demand for whole grain foods. Grain sector adjustments will occur largely in the feed grains sector and will be closely linked to developments in the sweetener, oilseed, meat, and poultry industries. Increased *planting flexibility* under the 1996 Federal Agriculture Improvement and Reform Act could help to facilitate feed sector adjustments by allowing producers to shift acreage between soybeans and feed grains in response to changing price incentives. There is some evidence that farmers are already exercising such flexibility (Westcott and Young, 1997).

Feed Use With more than one-third of total agricultural area in the United States devoted to feed grain production for domestic use, even a small increase in demand for meat or poultry products implies measurable adjustments in the feed grain sector (table 16). Increased poultry consumption, relative to red meat, for example, would increase demand for both feed grains (mostly corn) and oilseeds (mostly soymeal) (table 17). Meeting this demand shift domestically would require an additional 2-5 million acres to increase feed grain output. Up to 2 million additional acres of feed grain production could occur as producers shift from lower priced feed grains to higher priced soybean meal. Leaner red meats can be produced without an accompanying increase in feed grain demand through more efficient hog and cattle feeding (Nelson, 1987).

Corn Sweetener Use Higher feed grain prices relative to corn sweeteners would induce producers to shift field corn production from corn sweeteners to feed use. About 660 million bushels of corn, or about 8 percent of total field corn output, were used annually in 1991-95 to produce HFCS and other corn sweeteners (table 16). A 60-percent reduction in the demand for corn sweeteners implied by the Pyramid recommendations would reduce the sweetener industry's total field corn use about by 400 million bushels, or by about 3 million harvested acres (see "Caloric Sweeteners" discussion, page 6).

Given such a demand shift, corn supplies presently used for sweeteners likely would move into alternative uses. For example, corn supplies could be used to fill the feed grain deficit created by expanded meat and dairy production. Depending on relative prices, strong world demand could bid up export prices, and the domestic surplus of field corn for feed grain could be diverted to world markets instead of domestic supplies. It is unlikely that all of the surplus would end up in export markets, however. Even if all of the surplus corn generated by a drop in corn sweetener demand went to the export market, the 23-percent increase in corn exports implied by such a shift would be well within the bounds of the average annual variation in U.S. corn exports during 1991-95.

Nonsweetener Food Use With average consumption of wheat flour and other grain products already close to recommended levels, adjustments in non-

Table 16—The Grains Sector, 1991-95

	Million bushels
Corn:	
Production	8,150
Imports	15
Exports	1,800
Feed and other nonfood	5,770
Sweetener use	660
Food use	160
Wheat:	
Production	2,270
Imports	80
Exports	1,260
Feed use	240
Seed use	100
Food use	850
Barley, oats, rye, sorghum:	
Production	1,270
Imports	130
Exports	315
Feed and other nonfood	1,430
Food use	90
	Million hundredweight
Rice:	
Production	170
Imports	6
Exports	80
Nonfood use	30
Food use	70
	Million acres
Planted area:	
Corn	75.8
Wheat	70.7
Rice	3.1
Barley, oats, rye, and sorghum	23.9

Sources: Childs, 1996; Riley and Baker, 1997; and Schwartz, 1997.

sweetener food grain use likely will be relatively small. Increased consumption of foods made from whole grains will likely increase the share of grain foods (like wheat and rice) consumed in their whole-grain form and decrease production of more refined, less fiber-dense grain products (like white rice and white flour). Such changes would occur more at the milling, rather than production, level.

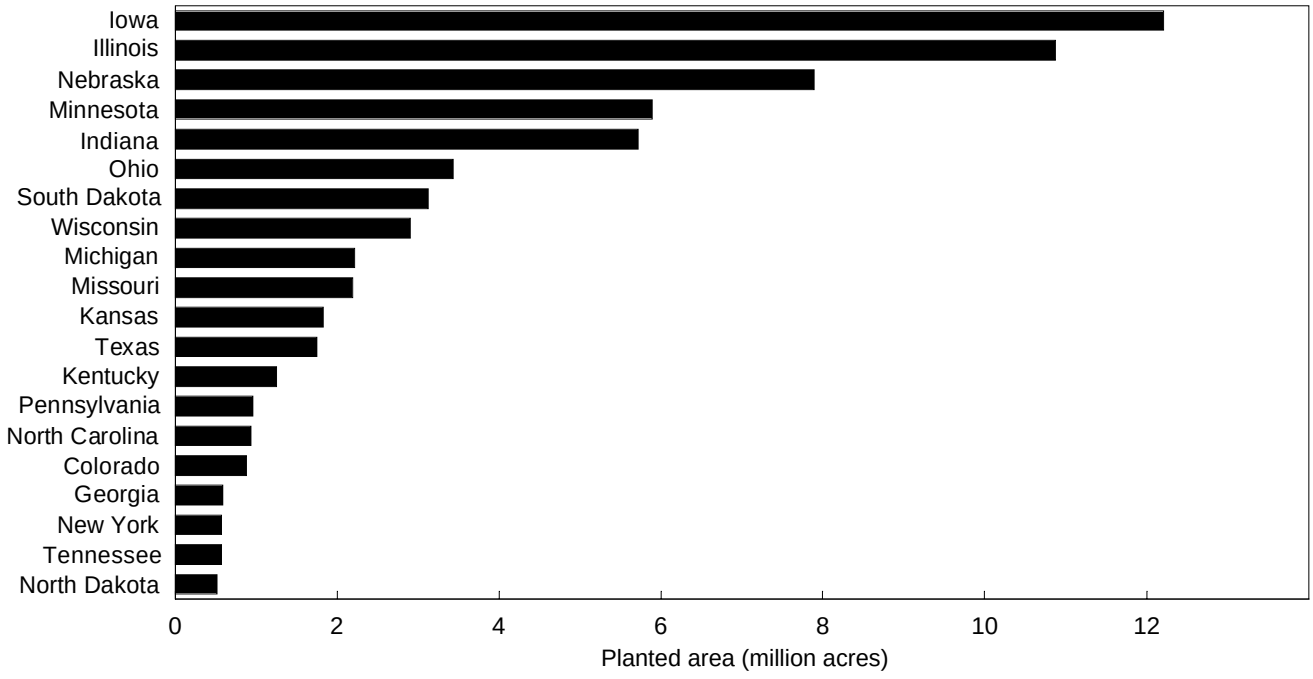
However, increased consumption of whole-grain foods could prompt changes in food grain demand. For example, more whole-grain product can be extracted per pound of grain—1 pound of wheat, for example, yields 0.98 pound of whole wheat flour, compared with 0.74 pound of white flour. With over 30 million acres of cropland used to produce grain for nonsweetener food use (including oats, barley, wheat, and rice), even a 1- to 2-percent change in food grain demand could reduce total grain area by as much as 0.5 million acres.

Table 17—Grains: Projected Changes in Supply, Demand, and Prices Implied by Pyramid Serving Recommendations

Item	Feed grains			Food grains
	From sweeteners	From oilseed production	From meat and dairy	
Supply components:				
Domestic production	↓	↑	↑	↑
Imports	*	*	*	*
Demand components:				
Food use	↓	*	*	↑
Exports	↑	--	--	--
Industrial uses	*	*	*	*
Prices	↓	↑	↑	↑

*These uses are relatively small, and the impacts were not evaluated.
-- = No change.
Source: USDA, Economic Research Service.

Figure 11
Corn Is Produced Across a Wide Geographic Area



Source: USDA, Economic Research Service.