Oilseeds

Background for 1995 Farm Legislation

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Soybeans

Soybeans are the second-highest valued crop in the United States, trailing only corn. The farm value of soybean production was $12 billion in 1993/94. U.S. soybean acreage planted fell from 71.4 million acres in 1979 (the peak year) to 61.9 million in 1994. Increasing yields have somewhat offset the loss of soybean acreage, resulting in relatively steady production since the early 1980's. Average U.S. yields rose from 32 bushels per acre in 1979 to a record 41.9 bushels in 1994. The combination of improved varieties and narrow-row seeding has boosted yields in the last 5 years.

Data from the 1992 Census of Agriculture indicated 381,000 farms in the United States (or 1 in 5 U.S. farms) grew soybeans, down from 511,000 in 1982. The harvested soybean acreage per farm increased to 148 acres in 1992 from 125 acres in 1987 and 114 acres in 1978. Although farms with less than 250 acres of soybeans accounted for 83 percent of the farms growing soybeans (table 1), these farms accounted for only 42 percent of U.S. soybean production in 1992. Twenty percent of these farms had at least half their total farm sales coming from soybeans. About 36 percent of U.S. farms had sales of $100,000 or more, while 13 percent had sales of less than $10,000 (table 2). Individual or family farms accounted for 83 percent of all farms producing soybeans and 72 percent of U.S. soybean production in 1992. Partnerships and small family-held corporations accounted for much of the remainder, while other corporations produced 0.4 percent of the total soybean crop.

Regional Production Differences

Over half of U.S. soybean farms and production are located in the five Corn Belt States (Illinois, Iowa, Indiana, Ohio, and Missouri). Soybean acreage in the North Central region (Corn Belt plus Minnesota and Nebraska) declined only slightly between 1979 and 1994. The soybean production area has begun expanding farther north and west into Wisconsin, Michigan, Minnesota, and the Dakotas. The success in breeding high-yielding, short-season soybean varieties has displaced acreage from flax, oats, sunflowers, dry beans, alfalfa, and land that would normally be fallowed. Incorporating soybeans into a rotation with corn or spring wheat has positive agronomic attributes, also aiding its northwestern expansion.

Nearly all of the decline in soybean acreage since 1979 occurred in the lower-yielding, higher-cost southern regions. Southern farmers who planted more soybean acreage during the rising prices of the 1970's cut back in the weaker market of the 1980's. Delta, Appalachian, and Southeast planted area declined by 49, 40, and 65 percent, respectively, between 1979 and 1994. These three regions accounted for 20 percent of U.S. acreage in 1994, compared with 37 percent in 1979.

Yield growth in the South has consistently trailed midwestern soybean yields as southern soybean acreage increasingly occurred on substandard soils, with the best land devoted to program crops. Double-cropped fields are typically planted later than optimal, which also hurts southern yield potential compared with full-season midwestern production. Greater flexibility and the return of Conservation Reserve acres to cultivation could accentuate the production shift from south to north. The prospects for southern acreage will greatly depend on future world demand for soybean oil and meal and the capability to improve yields and control production costs.

Production Practices

Acceptance of *conservation tillage*[1] systems has surged in recent years to nearly one-half of the soybean area planted. Some producers adopted

[1]Italicized words are defined in the glossary at the end of the report.

conservation tillage to meet *conservation compliance* requirements arising from 1985 and 1990 farm legislation. Conservation tillage includes *no-till*, *ridge-till*, and *mulch-till*. Mulch tillage is the dominant conservation system used in northern areas, although use of the no-till system increased from 3 percent of soybean acreage in 1988 to 14 percent in 1992. Illinois led the northern region in total number of soybean acres under conservation tillage (4.6 million) while Indiana ranked highest in percentage of acres (49). Conservation tillage is practiced less in the South, except for Kentucky and Tennessee. No-till is the primary conservation system used in the South as it is best suited for steeply sloping and less productive soils. No-till use in the South rose from 7 percent of total soybean acres in 1988 to 14 percent in 1992.

The crop rotation pattern has a bearing on the type of tillage system and input use. Double-cropping provides an opportunity for minimum tillage cultivation, as soybeans are planted into the stubble soon after the winter wheat harvest. Soybean double-cropping is declining with the loss of acres in the South. About 16 percent of soybean acreage on southern farms is double-cropped with winter wheat. The number of double-cropped soybean acres is linked to the profitability of wheat relative to other crops and acreage set-aside requirements for wheat. Double-cropped soybeans yield less than single-cropped acres because of later planting and depleted soil moisture and nutrients. But future soybean varieties may soon overcome yield reductions associated with day length.

In areas that receive less than 30 inches of precipitation per year, irrigation may be required for

Table 1—Distribution of soybean farms, by acres of soybeans harvested, 1992

Region	Farms by acres of soybeans harvested					Farms growing soybeans
	1-24	25-99	100-249	250-499	500 or more	
			Percent[1]			*Number*
Corn Belt	16.9	37.8	27.3	13.1	4.9	204,087
Lake States	19.0	40.9	26.1	10.8	3.3	55,713
Northern Plains	15.7	41.6	27.9	10.7	3.9	49,781
Appalachia	32.1	36.1	17.8	8.2	5.8	29,206
Delta	8.7	23.5	23.1	20.9	23.9	16,151
Southeast	22.4	40.5	22.7	9.2	5.2	10,688
Northeast	37.6	37.9	14.6	5.7	4.2	11,402
Southern Plains	10.8	38.4	28.3	15.7	7.0	3,181
United States	18.6	38.1	25.8	12.1	5.3	381,000[2]

[1]Totals may not add to 100 percent due to rounding.
[2]Regional totals do not add to U.S. total because not all farms are reported in each State.
Source: 1992 Census of Agriculture

Table 2—Distribution of soybean farms, by value of sales, 1992

Region	Value of sales					Farms growing soybeans
	$100,000 or more	$40,000-$99,999	$20,000-$39,999	$10,000-$19,999	Less than $10,000	
			Percent[1]			*Number*
Corn Belt	34.6	24.5	16.0	11.9	13.1	204,087
Lake States	35.2	24.4	15.1	11.7	13.6	55,713
Northern Plains	39.7	28.6	15.5	9.3	7.0	49,781
Appalachia	32.5	18.7	15.4	12.9	20.8	29,206
Delta	52.0	16.3	9.8	8.4	13.4	16,151
Southeast	33.0	17.4	13.4	12.4	23.8	10,688
Northeast	37.2	17.1	13.2	13.0	19.5	11,402
Southern Plains	43.0	25.4	13.2	8.7	9.7	3,181
United States	36.1	23.8	15.3	11.5	13.4	381,000[2]

[1]Totals may not add to 100 percent due to rounding.
[2] Regional totals do not add to U.S. total because not all farms are reported in each State.
Source: 1992 Census of Agriculture

successful double-cropping. Under irrigation, double-cropped yields are nearly equal to single-crop yields. U.S. farmers irrigated only 2.5 million acres of soybeans in 1992. Fifty-three percent of the irrigated acres were in Arkansas and Nebraska, which helps explain why about half of the U.S. soybean double-cropped acres are in Arkansas.

A soybeans-after-corn rotation requires more tillage to prepare the seedbed, but less when corn follows soybeans. A soybeans-corn rotation provides a more durable residue, which helps hold the soil in place, than a continuous soybean pattern. A better residue reduces the potential for leaching or runoff of chemicals into water supplies. Crop rotations also help manage soybean pests. The rotation of soybeans following soybeans allows pests to become established, requiring higher pesticide expenses. The most common crop rotation (57 percent of acres) in the major northern soybean-producing States is soybeans-corn-soybeans. In the South, however, the most common pattern (25 percent) is continuous soybean production. Continuous production is more widespread in the South because of fewer program base acres and different soil characteristics there.

The combination of greater pesticide and fertilizer use has made possible the highest soybean yields in the world. For all U.S. field crops, soybeans rank second (behind corn) in pesticide use at 114.3 million pounds (active ingredients) for 1993. Virtually all soybean acreage is treated with herbicides but seldom treated with insecticides or fungicides. USDA's 1993 cropping practices survey of eight major soybean-producing States asked producers about their pest control methods. A key element of *integrated pest management* (IPM) includes scouting, or the monitoring of pest levels to make pesticide decisions, taking into account crop prices, pesticide costs, and other factors. The survey reported 59 percent of soybean acreage had been scouted to determine herbicide application. Other common practices included crop rotation to control weeds (78 percent of soybean acres) and rotating herbicides (55 percent of acres). Adoption of conservation tillage has helped accelerate the trend toward using post-emergence herbicides in soybean production, which has much less residual soil activity than pre-emergence applications. However, farmers continue to use conventional methods because rains can delay exclusively applied post-emergence herbicides, which may result in weeds too large to kill effectively. This increases yield risk over pre-emergence programs. In 1992, 64 percent of soybean planted acres still received pre-plant herbicides (generally broadcast) to get the crop a good start over pests.

Soybeans have the lowest average acre-treatment for fertilizer of all the major field crops. Twenty-seven percent of soybean acres in the northern region were fertilized in 1992, compared with 39 percent in the South. Soybean fields are generally treated only once with fertilizer, usually prior to seeding in the spring. Application rates are highest for potash, followed by phosphorus and nitrogen. Southern regions also had higher per acre application rates of nitrogen and phosphates than the northern regions.

Costs of Production

Cash costs of producing soybeans increased in nominal terms from $56 per acre in 1980 to $73 in 1992 (table 3). But variable costs per bushel had no upward or downward trend from $2.18 per bushel in 1980 because of increasing yields. Real costs (adjusted for inflation) of production were about $20 per acre lower in 1992 than they were in 1981 (although they are higher now than in the 1986-88 period). Real costs per bushel peaked in 1981 and have since trended downward as variable costs have risen more slowly and U.S. average soybean yields more quickly than the general price level (Ali).

Analysis of USDA's Farm Costs and Returns Survey data has found that the nominal average variable cost for producing soybeans in 1990 was $2.11 per bushel (McBride, 1991). The low-cost enterprises accounted for 35 percent of soybean production. Low-cost producers had variable costs of $1.57 per bushel or less; high-cost producers $3.11 or more. Low-cost (high-cost) producers are defined as the 25 percent of U.S. soybean producers with the lowest (highest) per-bushel total variable costs. Low-cost soybean producers planted 54 more soybean acres and operated farms that averaged 85 acres larger than high-cost producers. High-cost producers were more likely to work off the farm and to spend more for hired labor. Returns above variable costs were $200 per acre for the low-cost group compared with only $14 per acre for the high-cost group and $124 for all soybean farms (table 4).

Low-cost producers of soybeans had a 43-percent higher average yield but spent less per acre on fertilizer and pesticides than all other soybean producers in 1990. The expenditure difference could be due both to bulk discounts on farm inputs available to large farms and to lower chemical use rates. About 65 percent of high-cost farms fertilized soybeans, compared with 19 percent of the low-cost farms. Low-cost producers most often planted soybeans after corn while high-cost producers planted continuous soybeans. Residual fertilizer from corn planted prior to soybeans

may have increased yield and reduced fertilizer requirements. Low-cost producers tended to use conservation tillage practices more frequently, as evidenced by lower fuel and labor costs in recent years. Differences in climate for low-cost producers (a proportionately higher representation in northern than in southern production regions) would also affect relative costs. Weed and insect problems are generally more serious on southern farms. The rotation with other crops and the cold winters of the North Central region help to control insects.

Growers in northern regions had variable costs $10-$20 per acre lower than growers in southern regions (table 5), meaning that many more producers in the North were able to cover variable costs at the prevailing prices than in the South. Nearly 62 percent of North Central producers had variable costs less than $2 per bushel, compared with 11 percent and 14 percent of Southeast and Delta producers, respectively (McBride). Fewer than 15 percent of southern producers were in the low-cost group. More than 70 percent

Table 3—U.S. soybean production costs, selected years, 1980-92

Item	1980	1984	1985	1986	1987	1988	1989	1990	1991	1992
					Dollars per planted acre					
Cash expenses:										
Seed	7.87	10.97	12.92	10.82	11.16	12.01	15.04	12.47	12.89	12.46
Fertilizer, lime, and gypsum	9.36	8.89	6.18	5.35	5.29	6.61	10.66	9.57	9.34	9.39
Chemicals	13.64	19.56	12.41	12.37	12.04	12.24	19.48	20.48	22.51	23.53
Custom operations	2.85	4.03	4.06	4.06	4.05	4.05	3.50	3.56	3.66	3.66
Fuel, lube, and electricity	12.23	8.42	11.62	7.39	8.97	9.12	8.27	9.06	9.49	8.46
Repairs	7.37	6.45	7.04	6.56	6.63	7.30	8.58	8.63	8.92	9.57
Hired labor	3.06	2.37	2.45	2.53	2.62	2.80	5.68	5.88	5.91	6.21
Other variable cash expenses[1]	0.00	0.36	0.00	0.00	0.00	0.00	0.04	0.04	0.04	0.04
Total variable cash expenses	56.38	61.05	56.68	49.08	50.67	54.13	71.25	69.69	72.76	73.32
General farm overhead	10.30	10.81	6.85	7.87	10.81	12.44	8.95	8.23	9.25	8.78
Taxes and insurance	10.43	11.94	12.85	13.46	13.94	14.39	16.25	15.63	17.14	17.10
Interest	9.76	33.82	20.32	18.16	19.02	19.20	12.08	13.35	15.54	12.76
Total fixed cash expenses	43.48	56.57	40.02	39.49	43.77	46.03	37.28	37.21	41.93	38.64
Total cash expenses	99.86	117.62	96.70	88.57	94.53	100.16	108.53	106.90	114.69	111.96
Economic (full ownership) costs:										
Variable cash expenses	56.38	61.05	56.68	49.08	50.67	54.13	71.25	69.69	72.76	73.32
General farm overhead	10.30	10.81	6.85	7.87	10.81	12.44	8.95	8.23	9.25	8.78
Taxes and insurance	10.43	11.94	12.85	13.46	13.94	14.39	16.25	15.63	17.14	17.10
Capital replacement	19.37	24.17	29.60	31.48	31.84	34.13	17.94	18.59	19.30	20.71
Operating capital	3.00	2.54	1.72	1.08	1.24	1.51	2.86	2.60	1.98	1.31
Other nonland capital	3.91	4.32	4.99	5.07	5.05	6.36	12.27	8.98	10.48	11.79
Land	64.98	52.71	48.16	43.63	45.56	52.22	46.69	49.86	47.32	50.72
Unpaid labor	11.52	8.94	9.22	9.53	9.86	10.54	16.06	16.96	18.40	19.29
Total economic costs	179.89	176.48	170.07	161.20	169.06	185.72	192.26	190.54	196.63	203.02

[1]Includes cost of purchased irrigation water.

Source: *Economic Indicators of the Farm Sector, Costs of Production, Major Field Crops & Livestock and Dairy, 1991*, U.S. Department of Agriculture, Economic Research Service.

Table 4—Soybean variable production costs and returns per acre, by variable cost group, 1990

Item	Low-cost producers	Mid-cost producers	High-cost producers	All FCRS farms
		Dollars		
Costs per bushel:				
Variable costs, actual yield	1.21	2.13	5.08	2.11
Variable costs, normal yield	1.24	1.96	3.28	1.93
Costs and returns per acre:				
Value of production [1]	252.67	195.00	106.53	193.90
Total variable costs	52.32	70.75	92.44	69.86
Seed	11.15	13.39	11.71	12.47
Fertilizer	2.74	9.77	18.78	9.57
Chemicals	18.00	21.52	21.05	20.48
Custom operations	1.75	3.43	5.95	3.45
Fuel, lube, and electricity	7.87	8.60	12.02	9.05
Repairs	8.11	8.83	9.80	8.82
Hired labor	2.56	5.05	13.03	5.88
Purchased irrigation water	0.01	0.06	0.00	0.04
Technical services	0.16	0.10	0.10	0.11
Returns above variable costs	200.32	124.25	14.09	124.03

[1]Value of production determined from the yield reported in the Farm Costs and Returns Survey and State-level soybean harvest-month prices.

Source: William McBride, *Characteristics and Production Costs of U.S. Soybean Farms, 1990*, U.S. Department of Agriculture, Economic Research Service.

Table 5—Soybean variable production costs and returns per acre, by region, 1990

Item	North Central	Southeast	Delta	Northern Plains	All FCRS farms
			Dollars		
Costs per bushel:					
Variable costs, actual yield	1.80	3.91	3.15	2.02	2.11
Variable costs, normal yield	1.71	2.88	2.61	1.85	1.93
Costs and returns per acre:					
Value of production[1]	220.62	128.49	140.79	166.07	193.90
Total variable costs	67.56	85.59	74.18	59.15	69.86
Seed	13.52	9.69	10.48	11.54	12.47
Fertilizer	8.39	23.12	5.45	2.60	9.57
Chemicals	21.51	19.50	19.34	16.47	20.48
Custom operations	3.85	2.25	3.80	2.26	3.45
Fuel, lube, and electricity	7.82	10.22	13.05	11.31	9.05
Repairs	8.25	9.54	10.79	9.52	8.82
Hired labor	4.06	11.24	11.17	5.06	5.88
Purchased irrigation water	0.03	0.00	0.00	0.19	0.04
Technical services	0.12	0.02	0.10	0.21	0.11
Returns above variable costs	153.06	42.90	66.61	106.92	124.03

[1]Value of production determined from the yield reported in the Farm Costs and Returns Survey and State-level soybean harvest-month prices.

Source: William McBride, *Characteristics and Production Costs of U.S. Soybean Farms, 1990*, U.S. Department of Agriculture, Economic Research Service.

of Southeast soybean farmers and more than 50 percent of Delta producers were in the high-cost group.

Southern farms that double-crop are able to lower average production costs for their enterprise by distributing their fixed costs over more production. Land costs and property taxes in the South were about one-third less (because of the lower productivity) than in the Midwest. But the average southern soybean farmer has covered full ownership costs (which include land and capital replacement costs) only once since 1980, when a midwestern drought in 1988 drove up prices nationwide. This explains the exodus of land and capital devoted to soybean production in the South over the last 15 years.

Domestic Uses of Soybeans

Soybean meal is still the most valuable component obtained from processing the soybean, ranging from 50 to 75 percent of the soybean's value. It is by far the world's most important protein feed, accounting for roughly 60 percent of world protein meal. Soybean meal competes with meals produced by crushing cottonseed, sunflowerseed, peanuts, and canola. U.S. exports account for 20-25 percent of total U.S. soybean meal production, resulting in $1.0-$1.5 billion per year in trade.

Over the last decade, edible use of soybean oil in the United States has increased about 3 percent per year. This growth rate matches the consumption growth for all edible oils so that soybean oil has maintained a relatively constant (about 73 percent) proportion of total edible oil use. However, consumption of two vegetable oil substitutes, canola and corn oil, has increased faster than consumption of soybean oil. In 1993/94, salad and cooking oils accounted for 42 percent of edible use of soybean oil, followed by baking and frying fats (40 percent) and margarine (16 percent). The development of no-calorie "fat mimics" and engineered fat substitutes could soon revolutionize the use of edible oils.

Soy flours are made by finely grinding soybean flakes before or after removal of oil. In the United States, soy flours are used primarily for bread and bakery products. Whole soybeans may be used to produce textured soy protein for meat extenders, isolated proteins for dairy substitutes, and oriental foods such as *tofu*, *miso*, *tempeh*, or soy sauce. Domestic demand for these products has expanded slowly outside the vegetarian and Asian-American communities. Consumption of soybeans for food use in the United States was estimated for 1992 at 1.6 million bushels.

The gross processing margin is the difference between the price of soybeans and the value of the soybean products: oil and meal. The margin indicates the cost, including profit, of providing crushing services. A number of factors influence the margin. These include fluctuations in soybean supply and demand, the buying practices of the processor, location and size of the processor, competition for soybean purchases, and product yields per bushel of soybeans. The average gross margin for the last 5 years was 91 cents per bushel, compared with 80 cents for 1984/85-1988/89.

Industrial Uses of Vegetable Oils

Vegetable oil derivatives (or oleochemicals) are used in a wide variety of industrial applications. These include soap, cosmetics, *surfactants*, lubricants, paints and varnishes, solvents, resins and plastics, *stabilizers*, *emulsifiers*, pesticides, and other *fatty acids*. Less than 300 million pounds of domestically produced soybean oil is used for industrial purposes (table 6), which is less than 3 percent of total consumption. Research is accelerating to further expand the applications of these environmentally friendly materials, to products such as nylon, breast implants, and fuel.

Printing inks now commonly use soybean oil as a carrier for pigments and other components. Color inks are readily accepted because a soyoil-based carrier makes more efficient use of pigments, which is the principal cost component of color inks. For U.S. daily newspapers that use color inks, 90 percent now use color soy ink because of its superior visual quality and lower toxicity over conventional petroleum-based inks. Soy inks have one-tenth the emission of volatile organic compounds (VOC), air pollutants that form ground-level ozone. The adoption of soybean oil base for black newsprint inks has been slower, with only 25 percent of the over-300-million-pound market. However, improved, cost-effective formulations are rapidly emerging to tap into a much larger printing market. In 1990, newspapers accounted for only 7 percent of the potential printing ink market of 3.5 million tons, while magazines accounted for 27 percent, commercial printing 19 percent, and books 18 percent. Congress passed a bill in late 1994 to mandate the use of vegetable oil-based inks for all Federal publications (about 2.4 million pounds) whenever technologically feasible. Several State governments have instituted similar regulations for State-contracted print jobs.

The nontoxic and biodegradable features of biodiesel make it an attractive potential fuel source in environmentally delicate areas, such as rivers, bays, parks,

and forests. The Clean Air Act Amendments of 1990 (CAAA) require on-road diesel engines and city buses, beginning in 1995, to reduce emissions of particulate matter, hydrocarbons, carbon monoxide, and nitrogen oxides. Several demonstration projects have begun on a biodiesel blend (80 percent petrodiesel, 20 percent soybean oil) to determine exhaust emission and engine wear levels when used in truck and city bus fleets. This blend can reduce particulate levels by 27 percent and hydrocarbons by 50 percent, and can reduce nitrous oxides provided an engine timing change is made. This biodiesel blend represents a potential market of 50 million gallons (350 million pounds) of soybean oil annually. Biodiesel would require few engine modifications, and maintenance and refueling would be more convenient than with other alternatives (propane, compressed natural gas, methanol). Initial cost estimates of operating bus engines with biodiesel appear to be favorable compared with other alternatives, but its 40-100 percent premium over diesel will relegate it to niche markets where regulatory or environmental issues are a concern. Costs could be reduced through manufacturing improvements and higher-oil-yielding soybeans, although it is unlikely that refined soybean oil would be the first source for biodiesel feedstocks, as tallow, waste restaurant grease, and palm oil are more price-competitive. Interest in biodiesel has also increased in the European Union (EU) since the Common Agricultural Policy (CAP) reform limits oilseed acreage for food, but permits production for industrial uses.

The CAAA also require paint manufacturers to reduce volatile organic compounds in their formulations as surface coatings are the largest single source of VOC's. Epoxidized soybean oil (ESO) derivatives may partially replace petroleum-based chemicals as paint solvents. ESO is also a heavily used plasticizer, for molding plastic resins into bottles, bags, and other products. As ESO use expands into coatings, the market could eventually reach 250-300 million pounds annually, more than double its current size. These materials have a relatively high value (50-75 cents per pound) compared with edible uses.

With further research, there is also a large potential market for soy-based wood adhesives. Wood composite (including particle board, fiberboard, and plywood) manufacturing uses formaldehyde-based adhesives, which emit VOC's.

In early 1994, soybean farmers approved by referendum a nationwide checkoff that funds market development, promotion, consumer education, and research of soybeans. Farmers contribute 50 cents on each $100 of soybean sales. Half of the approximately $50 million to be raised annually will be spent nationally by the United Soybean Board and half will be returned to State organizations. Research into new uses for soybeans (including the National Soy Diesel Board) and ways to lower production costs are key goals of the farmer-funded program.

Table 6—Consumption of soybean oil in inedible products, 1979-93

Year[1]	Total edible	Total inedible[2]	Soap	Paint and varnish	Feed	Resins and plastics	Lubricants	Fatty acids
				Million pounds				
1979/80	8,493.3	205.1	0.0	51.9	0.0	79.8	0.0	21.2
1980/81	8,610.2	202.3	0.0	45.7	0.0	70.9	0.0	22.8
1981/82	9,132.6	202.8	0.0	38.9	0.0	93.7	0.0	21.5
1982/83	9,282.3	204.7	0.0	38.0	D	96.3	D	15.9
1983/84	9,245.4	231.0	D	39.3	D	109.6	D	20.8
1984/85	10,171.6	251.5	10.2	51.7	D	92.9	D	29.1
1985/86	10,003.7	279.5	D	59.5	D	98.7	D	31.5
1986/87	10,212.7	299.5	D	63.2	D	109.2	D	D
1987/88	10,429.1	285.3	2.7	54.1	D	106.1	D	D
1988/89	9,635.8	281.8	1.5	34.9	D	123.7	D	D
1989/90	10,536.7	271.6	D	38.2	D	112.4	D	D
1991	10,966.7	301.0	D	49.2	D	104.7	D	D
1992	11,168.7	302.8	D	43.5	22.3	94.0	5.9	D
1993	12,200.9	294.7	D	38.7	23.7	98.1	5.8	D

[1] Crop year runs from October 1 to September 30. Annual totals reported on a calendar year basis beginning in 1991.
[2] Includes other inedible uses.
D= Data withheld to avoid disclosing figures for individual companies.
Source: *Fats and Oils—Production, Consumption, and Stocks.* Bureau of the Census, Department of Commerce.

An expansion in uses for soybean oil (all other things held constant) would increase the value of oil relative to soybean meal. Soybean breeders would have an incentive to develop high-oil-yield varieties.

Trends in World Production and U.S. Share

World soybean production has been on a sharp upward trend since 1964. Most of the growth in soybean production has come from increases in area rather than higher yields. For example, between 1964 and 1993, soybean production rose at an annual rate of 4.6 percent, with area growing 2.8 percent per year and yields only 1.6 percent. Global soybean production in 1994/95 is expected to rise 15 percent from 1993/94 to 135 million tons.

Five countries account for about 90 percent of the world's soybean production. Despite a continuous decline in production share from 90 percent in 1970, the United States remains the leading soybean producer, with approximately 50 percent of world production. In 1980, the United States had 27 percent of the world's oilseed area but dropped to 21 percent by 1994. Brazil, Argentina, China, and India are the next largest producers of soybeans. Brazil's and Argentina's shares of world soybean production are expected in 1994/95 to be about 20 and 10 percent, respectively, while China and India produce 13 and 4 percent of world soybean output.

In Brazil, production rose from 2 million tons in 1970 to an anticipated 24 million in 1994, representing the largest growth rate during the 1970's. Argentina increased production from a negligible 59,000 tons in 1970 to a projected 12.7 million in 1994. China's and India's soybean production are estimated at 13.3 and 3.3 million tons in 1994/95, respectively. Most of the production expansion in these countries has occurred since 1980. Production has also recently expanded in Indonesia, Canada, and Paraguay.

Trends in World Soybean Consumption

Year-to-year global soybean crush has expanded in 25 of the last 30 years. The annual growth for global crush (5.2 percent) is greater than the rate for total production over the same period. The United States, Brazil, Argentina, China, and the EU account for about 80 percent of total world soybean consumption. Developed countries account for approximately 65 percent of total global soybean crush.

World soybean meal consumption is more widely spread than soybeans through a large number of countries. Although developing countries account for only 25 percent of total world soybean meal consumption, their consumption since 1965 has grown at a faster rate (7 percent) than overall global growth. Slower growth in consumption of soybeans and soybean meal is expected to continue in developed countries, while future growth in soybean meal consumption will be driven mainly by developing countries.

Trends in World Soybean Trade and U.S. Share

World soybean exports account for approximately 25 percent of world soybean production. This compares with 18 percent for wheat, 11 percent for corn, and 4 percent for rice. In addition, soybean exports are approximately 75 percent of international trade in oilseeds.

Most of world soybean exports come from the Western Hemisphere, with the United States exporting about 60-70 percent of world exports and Brazil and Argentina combined 20-25 percent. Other major producers, such as China and India, consume most of their soybean production domestically, which restricts supplies for export.

World soybean exports increased steadily from 6.5 million tons in 1964 to about 29 million tons in 1979 (table 7). However, between 1980 and 1994, world soybean trade remained at approximately the same level. World imports of soybeans are dominated by the EU, Japan, Taiwan, and Mexico (table 8). These countries accounted for approximately 80 percent of world soybean imports. Despite a continuing proportional decline, the EU remains the world's most important import market for soybeans, with a market share of nearly 48 percent.

Several factors have contributed to the lack of growth in soybean trade. Developed countries, especially the EU and Japan, are the primary importers of soybeans. Income growth in developed countries has resulted in declining food expenditures as a percent of income, limiting the demand for soybean products and soybean imports. Also, significant supplies of inexpensive soybean meal from South America led to some shift between soybean and soybean meal imports.

U.S. soybean exports are closely related to U.S. production and consumption. During the 1970's, U.S. production increased faster than consumption, expanding the availability of soybeans for exports. In the 1980's, U.S. soybean production remained nearly constant (primarily because of lower soybean prices and higher support for grains and cotton) but consumption

continued to grow, restricting U.S. soybean export capacity. From the 1969-71 period to 1994/95, the U.S. share of world soybean trade dropped from an average of about 92 percent to 66 percent. Although the United States lost about 10 percent in its share of soybean world trade between 1970 and 1980, U.S. exports increased nearly 9 million tons in the same period. However, during the 1980's, the U.S. share decreased about 20 percent, while U.S. soybean exports dropped by approximately 5 million tons. A stronger dollar and expansion of the domestic livestock sector were key features of this period.

World Soybean Meal Exports and Imports

In contrast to world soybean exports, soybean meal exports have continued to grow since 1964. World soybean meal exports expanded from 2.8 million tons in 1964 to a projected 29.7 million tons in 1994 (table 9). The contrast between meal and soybeans is primarily a result of expanded demand for soybean meal in developing countries relative to stable soybean im-

Table 7—World soybean exports, major exporters and regions, 1964-94

Crop year[1]	World	United States	Argentina	Brazil	China
			1,000 metric tons		
1964/65	6,548	5,774	0	75	577
1965/66	7,592	6,820	0	121	550
1966/67	8,125	7,119	0	305	565
1967/68	7,993	7,255	0	66	571
1968/69	8,675	7,805	0	310	488
1969/70	12,571	11,773	0	290	424
1970/71	12,576	11,806	0	230	460
1971/72	12,906	11,344	0	1,023	370
1972/73	15,441	13,048	0	1,788	310
1973/74	18,086	14,673	0	2,862	340
1974/75	15,580	11,450	0	3,516	330
1975/76	19,229	15,107	111	3,328	178
1976/77	19,137	15,351	623	2,581	115
1977/78	22,339	19,061	1,969	659	90
1978/79	24,658	20,117	2,776	638	274
1979/80	29,063	23,818	2,726	1,533	207
1980/81	24,538	19,712	2,190	1,502	143
1981/82	29,539	25,285	2,151	797	110
1982/83	28,554	24,634	1,338	1,316	320
1983/84	26,372	20,215	3,132	1,580	800
1984/85	24,912	16,279	2,954	3,456	1,080
1985/86	26,101	20,158	2,566	1,192	1,260
1986/87	28,515	20,600	1,292	3,290	1,750
1987/88	30,422	21,870	2,100	3,020	1,482
1988/89	23,850	14,356	516	5,080	1,209
1989/90	28,112	16,952	3,511	4,220	1,107
1990/91	24,204	15,159	4,127	1,645	1,288
1991/92	28,255	18,615	3,050	3,826	1,090
1992/93	29,586	20,944	2,216	4,057	300
1993/94[2]	28,065	16,032	3,054	5,464	1,100
1994/95[3]	32,502	21,500	3,000	4,650	500

[1] Based on aggregate of differing local marketing years.
[2] Preliminary.
[3] Forecast.
Source: U.S. Department of Agriculture, Foreign Agricultural Service, Oilseeds and Products Division: Production, supply, and distribution database, December 1994.

ports by developed countries. World soybean meal exports account for nearly 70 percent of total world protein meal trade. The EU is still the largest import market, although Asian buyers are rapidly increasing their demand (table 10).

The U.S. share of world soybean meal exports is about 18 percent. Strong domestic demand for soybean meal and large exports of meat could have partly replaced some meal exports. On the other hand, South America, which became a major competitor for U.S. soybean meal markets during the mid-1970's, increased its share from 25 percent in 1974 to about 58 percent in 1993/94 and is expected to continue growing in the near future. Low costs, fertile and abundant land, increasing soybean supplies, large currency devaluations, and favorable trade policies such as differential export taxes (DET) in Brazil and Argentina made South American soybean producers extremely competitive in world markets, especially for soybean products.

Recently, India has dramatically expanded production of oilseeds, including soybeans, to meet rising demand for domestic edible oil. But demand for soybean meal within India is low, so its large surplus of meal has been exported, primarily to other Asian countries. This has hampered growth of U.S. exports

Table 8—World soybean imports, major importers and regions, 1964-94

Crop year[1]	World	EU[2]	Japan	All Asia	East Europe	Mexico	Latin America
			1,000 metric tons				
1964/65	6,666	3,417	1,864	2,112	115	3	49
1965/66	7,670	4,173	2,178	2,415	79	5	67
1966/67	8,249	4,537	2,183	2,615	107	7	64
1967/68	8,384	4,556	2,435	2,877	70	8	77
1968/69	9,327	5,058	2,604	3,148	175	22	93
1969/70	12,343	7,013	3,257	4,012	119	133	223
1970/71	12,647	7,170	3,226	3,898	184	62	179
1971/72	13,935	8,048	3,396	4,253	114	18	145
1972/73	14,880	7,971	3,635	4,720	176	50	198
1973/74	17,290	10,765	3,244	4,524	236	271	418
1974/75	16,365	10,074	3,334	4,349	128	118	230
1975/76	19,883	11,438	3,554	4,811	316	135	277
1976/77	19,716	11,277	3,602	4,897	189	498	642
1977/78	23,115	13,608	4,260	5,916	603	551	834
1978/79	25,857	14,654	4,132	6,241	699	589	1,032
1979/80	28,289	16,233	4,165	6,669	925	711	1,394
1980/81	26,214	13,219	4,213	6,961	515	1,370	2,613
1981/82	29,233	15,947	4,486	7,367	477	566	2,440
1982/83	28,428	15,557	4,871	7,628	783	1,070	1,738
1983/84	25,724	12,891	4,728	7,319	829	1,805	2,405
1984/85	25,533	12,901	4,611	7,458	572	1,472	2,330
1985/86	27,516	13,228	4,796	8,442	784	877	1,568
1986/87	29,367	14,442	4,866	8,851	753	1,092	2,455
1987/88	28,697	13,583	4,847	9,481	727	956	2,061
1988/89	24,303	11,153	4,286	8,388	422	1,220	2,368
1989/90	26,925	13,265	4,667	9,148	778	945	1,659
1990/91	25,945	12,797	4,375	8,783	494	1,376	2,296
1991/92	29,274	13,775	4,672	9,829	276	2,100	3,259
1992/93	29,989	14,809	4,866	9,926	300	2,136	2,887
1993/94[3]	28,434	13,049	4,855	10,120	258	2,150	3,883
1994/95[4]	32,152	14,868	4,800	10,702	433	2,250	3,208

[1]Based on aggregate of differing local marketing years.
[2]Includes intra-EU trade.
[3]Preliminary.
[4]Forecast.
Source: U.S. Department of Agriculture, Foreign Agricultural Service, Oilseeds and Products Division: Production, supply, and distribution database, December 1994.

Table 9—World soybean meal exports, major exporters and regions, 1964-94

Marketing year[1]	World	United States	Argentina	Brazil	EU[2]	China	India
			1,000 metric tons				
1964/65	2,826	1,847	0	105	606	0	0
1965/66	3,534	2,360	0	185	749	0	0
1966/67	3,498	2,410	0	125	759	0	0
1967/68	3,869	2,630	0	235	798	0	0
1968/69	4,274	2,762	0	310	991	0	0
1969/70	5,728	3,661	0	580	1231	0	0
1970/71	6,719	4,136	0	990	1364	0	0
1971/72	6,888	3,452	0	1,506	1,670	23	0
1972/73	8,157	4,304	14	1,373	2,167	0	0
1973/74	10,068	5,033	12	2,396	2,263	21	0
1974/75	9,648	3,900	158	3,450	1,740	25	0
1975/76	11,182	4,667	251	4,078	1,909	16	0
1976/77	11,910	4,136	325	5,329	1,818	17	0
1977/78	14,453	5,516	370	5,368	2,789	30	40
1978/79	14,969	5,997	260	5,038	3,116	31	50
1979/80	18,852	7,196	277	6,936	3,767	66	60
1980/81	19,880	6,154	591	8,562	3,904	185	107
1981/82	20,773	6,266	1,209	7,822	4,547	289	200
1982/83	23,324	6,449	1,765	7,994	5,861	586	225
1983/84	21,962	4,862	2,663	7,690	5,396	694	250
1984/85	22,112	4,426	2,521	8,628	5,160	650	350
1985/86	22,807	5,476	3,248	6,961	5,081	1,116	450
1986/87	25,742	6,617	3,600	8,030	5,081	1,542	450
1987/88	26,998	6,191	5,350	8,477	3,827	2,343	360
1988/89	25,429	4,937	4,350	9,577	3,541	1,600	890
1989/90	25,680	4,825	4,860	8,994	3,824	1,600	950
1990/91	26,806	4,962	6,294	7,414	3,732	2,250	1,420
1991/92	28,127	6,301	6,330	8,151	3,968	1,400	1,180
1992/93	27,376	5,653	6,538	7,987	3,964	400	2,005
1993/94[3]	29,336	4,859	6,939	10,050	3,660	700	2,020
1994/95[4]	29,660	5,284	6,971	9,815	3,979	500	2,020

[1]Based on aggregate of differing local marketing years.
[2]Includes intra-EU trade.
[3]Preliminary.
[4]Forecast.
Source: U.S. Department of Agriculture, Foreign Agricultural Service, Oilseeds and Products Division: Production, supply, and distribution database, December 1994.

of soybeans and soybean meal, as Asian consumers have replaced declining Chinese soybean and meal exports with lower priced meal from India.

World Soybean Oil Exports and Imports

Soybean oil is the most common edible oil produced and consumed in the world, accounting for about 25 percent of the production and consumption of the nine major edible oils[2] in the world market. Soybean oil is second only to palm oil in world trade, with 20 percent of international trade. Soybean oil trade accounts for 25 percent of world production. Exports from the United States, Argentina, the EU (including intra-EU trade), and Brazil represent more than 90 percent of world soybean oil exports. Unlike exporters, there are a large number of soybean oil importers, with Asia, Latin America, and the Middle East as the most important regions. These are countries that have greater deficits of edible oils than they have for livestock feeds.

Between the early 1960's and the early 1980's, world soybean oil trade increased from an average of 600,000 tons to about 4 million tons (table 11). But from the mid-1980's to 1992, world soybean oil trade stabilized at about the 1983 level. Soybean oil trade increased substantially during 1993/94 and is expected to rise even more in 1994/95. Low supplies of palm

[2]The major edible oils include soybean, rapeseed, sunflowerseed, peanut, cottonseed, palm, coconut, olive, and fish.

oil, combined with high demand in developing countries (especially China), have pushed soybean oil trade to nearly 5 million tons. Vegetable oil imports are dominated by low-income importers that are highly price-sensitive (China, India, Pakistan, Bangladesh, Egypt, and Latin America) (table 12). India's oil imports have dropped dramatically in the last 10 years because of higher domestic production.

U.S. soybean oil exports account for less than 10 percent of domestic soybean oil production. Moreover, U.S. market share of world soybean oil exports dropped from 75 percent in 1964 to 17 percent in 1994, while its production was growing ever larger. The decline in U.S. trade market share is associated with increasing domestic consumption of soybean oil, exports from South America, and production of other oilseeds in the EU. In the 1980's, EU oilseed producers benefited from support regimes which had the effect of reducing dependence on imported oilseeds and particularly foreign sources of protein. In addition, during the last 10 years, trade of palm oil more than doubled, flooding the world's edible oil market and hindering U.S. exports of soybean oil.

Recently, U.S. soybean oil exports have become dependent on government-assisted programs, such as credit guarantees, the *Export Enhancement Program (EEP)*, and food aid (PL-480). Enacted in 1986, the focus of the EEP program is to counter competitors'

Table 10—World soybean meal imports, major importers and regions, 1964-94

Marketing year[1]	World	Mexico	EU[2]	FSU	Japan	All Asia
			1,000 metric tons			
1964/65	2,882	27	2,138	0	46	57
1965/66	3,532	18	2,743	0	7	18
1966/67	3,703	14	2,760	0	2	35
1967/68	3,919	2	2,995	0	15	61
1968/69	4,521	1	3,472	0	27	87
1969/70	5,662	3	4,092	0	72	166
1970/71	6,648	105	4,853	0	39	135
1971/72	7,652	58	5,373	0	52	163
1972/73	8,568	13	5,593	0	277	331
1973/74	9,213	36	5,832	0	132	241
1974/75	8,951	25	5,836	0	18	226
1975/76	10,951	7	7,068	0	193	491
1976/77	11,759	190	7,125	0	314	748
1977/78	14,576	95	9,307	0	340	898
1978/79	15,665	91	9,820	52	283	975
1979/80	17,932	169	10,919	345	262	1,019
1980/81	18,759	150	10,556	966	290	1,113
1981/82	21,038	41	13,181	1,103	103	1,214
1982/83	23,094	180	13,430	2,812	177	1,465
1983/84	22,408	0	13,752	827	181	1,591
1984/85	22,869	106	14,308	550	94	1,167
1985/86	23,973	81	14,896	478	234	1,651
1986/87	26,631	102	14,636	2,900	204	1,838
1987/88	25,252	184	12,555	1,768	552	2,223
1988/89	26,395	317	12,210	2,456	377	2,285
1989/90	25,619	328	13,587	1,503	597	2,325
1990/91	27,151	260	13,908	1,816	839	3,143
1991/92	28,293	365	13,955	2,100	907	3,704
1992/93	27,001	395	14,195	1,050	871	4,297
1993/94[3]	28,710	370	14,450	1,016	875	4,657
1994/95[4]	29,418	425	14,750	1,070	850	4,590

[1]Based on aggregate of differing local marketing years.
[2]Includes intra-EU trade.
[3]Preliminary.
[4]Forecast.
Source: U.S. Department of Agriculture, Foreign Agricultural Service, Oilseeds and Products Division: Production, supply, and distribution database, December 1994.

unfair subsidies and trade practices in targeted markets. Wheat and wheat flour sales have dominated the EEP expenditures since the inception of the program. Vegetable oils, as of 1987, were included in the EEP initiatives, with soybean oil accounting for a majority of the EEP vegetable oil sales.

Nevertheless, these programs have not curbed the constant decline of U.S. world soybean oil exports. U.S. vegetable oil exports are a small component in the U.S. supply and demand balance, accounting for only 14 percent of total vegetable oil production. Soybean oil outranks other edible oils in production, consumption, and exports in the United States, with approximately 75 percent of the vegetable oil market.

During 1991-93, the United States exported an average of 1.2 million metric tons of vegetable oils per year, accounting for only 5 percent of global vegetable oil trade. Over the same period, the U.S. produced nearly 38 percent of the world's soybean oil, and exported roughly 14 percent of world trade.

The United States also supports vegetable oils through a variety of import duties. The general import duty for soybean oil (22.5 percent ad valorem) is higher than for other vegetable oils, such as canola oil and

Table 11—World soybean oil exports, major exporters and regions, 1964-94

Marketing year[1]	World	United States	Argentina	Brazil	EU[2]
			1,000 metric tons		
1964/65	779	608	0	0	115
1965/66	579	419	0	0	112
1966/67	676	488	0	0	148
1967/68	629	437	0	0	151
1968/69	684	395	0	0	240
1969/70	1,107	644	0	3	395
1970/71	1,365	790	0	7	461
1971/72	1,211	634	0	38	454
1972/73	1,137	484	22	82	490
1973/74	1,464	651	33	16	718
1974/75	1,545	466	20	320	721
1975/76	1,708	443	67	430	749
1976/77	2,161	702	64	560	814
1977/78	2,691	933	59	522	1,154
1978/79	2,912	1,059	102	459	1,253
1979/80	3,531	1,220	88	809	1,323
1980/81	3,434	740	84	1,212	1,299
1981/82	3,635	942	220	873	1,489
1982/83	3,769	918	298	947	1,472
1983/84	3,945	827	504	920	1,574
1984/85	3,617	753	544	935	1,307
1985/86	3,118	570	649	413	1,389
1986/87	3,918	538	800	975	1,367
1987/88	4,010	850	1,030	661	1,157
1988/89	3,750	754	868	864	1,016
1989/90	3,943	614	1,006	887	1,136
1990/91	3,516	354	1,266	410	1,172
1991/92	4,506	747	1,295	710	1,424
1992/93	4,240	644	1,451	689	1,099
1993/94[3]	4,959	694	1,500	1,336	1,047
1994/95[4]	4,942	885	1,451	1,000	1,186

[1]Based on aggregate of differing local marketing years.
[2]Includes intra-EU trade.
[3]Preliminary.
[4]Forecast.
Source: U.S. Department of Agriculture, Foreign Agricultural Service, Oilseeds and Products Division: Production, supply, and distribution database, December 1994.

palm oil, which are duty free. Import duties prevent significant imports of soybean oil but enable imports of substitute oils.

Issues Affecting U.S. Competitiveness in World Soybean Trade

International factors affecting U.S. competitiveness include foreign and domestic trade policies in key importing/exporting countries, relative prices and yields, transportation and infrastructure costs, and exchange rates.

Relative to other commodities, nearly all soybean exporters offer little or no explicit support for soybean and product exports. Virtually all major non-U.S. soybean and soybean meal exporters are developing countries with limited funds to subsidize exports or production. The transportation and marketing systems in Brazil and Argentina are less efficient than those in the United States, which adds to the costs of exporting. Soybean exports in both countries are implicitly taxed through a system of differential export taxes (DET), which lower domestic prices for soybeans. However, this system has supported the production of value-added oilseed products (meal and oil) since the early 1980's. This policy resulted in these countries becoming the two largest exporters of soybean meal and soybean oil in the world.

Historically, Brazil has provided direct support to the agricultural sector through negative interest rates,

Table 12—World soybean oil imports, major importers and regions, 1964-94

Marketing year[1]	World	EU	North Africa	China	Latin America
			1,000 metric tons		
1964/65	718	218	74	0	56
1965/66	550	127	54	0	67
1966/67	534	113	85	0	70
1967/68	503	108	89	0	81
1968/69	691	154	111	0	74
1969/70	995	260	106	0	112
1970/71	1,274	289	165	0	111
1971/72	1,070	249	107	10	97
1972/73	1,016	236	79	58	148
1973/74	1,483	428	147	0	260
1974/75	1,496	392	152	11	265
1975/76	1,587	352	130	13	239
1976/77	2,150	426	188	85	265
1977/78	2,667	509	189	184	347
1978/79	2,918	521	254	125	428
1979/80	3,101	574	264	100	373
1980/81	3,353	525	229	73	470
1981/82	3,502	596	281	31	563
1982/83	3,725	611	250	20	621
1983/84	4,033	640	261	0	765
1984/85	3,449	581	222	21	621
1985/86	3,130	564	123	210	584
1986/87	3,765	577	183	450	443
1987/88	3,562	497	164	220	473
1988/89	3,448	496	199	385	398
1989/90	3,960	473	207	520	498
1990/91	3,671	595	138	459	557
1991/92	3,879	581	326	218	723
1992/93	4,040	464	414	100	749
1993/94[2]	4,852	457	522	980	894
1994/95[3]	4,801	438	540	900	796

[1]Based on aggregate of differing local marketing years.
[2]Preliminary.
[3]Forecast.
Source: U.S. Department of Agriculture, Foreign Agricultural Service, Oilseeds and Products Division: Production, supply, and distribution database, December 1994.

minimum price support, and input subsidies. However, since 1990, government policies have been eliminated or significantly reduced. The rural credit system, once a major support policy, was significantly affected when the government reduced the level of subsidies. Since interest rates are now positive for farmers, a new credit-swap system has been developed among farmers, cooperatives, crushers, and exporters. Other programs also eradicated included the minimum price system and an export registration system that controlled soybean exports to maintain an adequate domestic supply for crushing. Overall support programs that have not been eliminated are expected to be maintained at a minimum level.

Brazil has State and Federal taxes that provide an incentive to export soybean products rather than soybeans. In addition, a "drawback" system allows processors to import soybeans free of duty if they export the corresponding products. Brazil frequently imports U.S. soybeans to sustain near-capacity crush rates.

In Argentina, agricultural policy for soybean and soybean meal exports is not expected to change significantly in the next decade. Under the Uruguay Round agreement, Argentina will likely maintain its DET, and continue favoring exports of meal and oil over soybeans. The current Argentine Government has embarked on a series of new macro-economic policies with the objectives of privatizing national entities, lowering inflation, and fixing the exchange rate.

Argentine farmers have received little assistance from their government. Over the years, export taxes, combined with marketing deficiencies and poor infrastructure, resulted in significant misallocation of Argentine resources. However, with the privatization of economic sectors, the slowdown of inflation, and the reduction of export taxes, the Government of Argentina has improved the competitive status of Argentine farmers. Argentina also eliminated most artificial financial incentives to export, such as an undervalued exchange rate. Argentina maintains an export tax of 3.5 percent on oilseeds (but none on oilseed products) that promotes the export of processed products, instead of soybeans. In addition, there is an export tax rebate of 2.5 percent which is provided on exports of oilseed products.

Formerly the world's largest soybean oil importer, India's oilseed production expanded dramatically in response to self-sufficiency policies adopted in 1987. The drain on foreign exchange, combined with a goal of increasing farm income, led India to restrict imports of oilseeds and products. Despite the introduction of more open trade policies, India remains one of the largest restricted oilseed markets in the world, affecting world oilseed marketing and trade. India's agricultural policy will continue to promote oilseed production to supply oil for the domestic market. This policy will result in a significant increase in India's soybean meal exports, especially to Asia, because of its small internal market.

The changing pattern of trade in soybeans and soybean meal with the former Soviet Union (FSU) also has contributed to a lower U.S. market share in the 1980's and 1990's. In 1987/88, following 8 years without bilateral soybean and soybean meal trade, the United States regained 44 percent of the FSU soybean meal market. Since then, the FSU has been a major market for U.S. soybean meal exports, accounting for an average of about 28 percent of total U.S. soybean meal exports annually from October 1987 through September 1992.

Nevertheless, in November 1992, the FSU defaulted on a series of GSM-102 loans, forcing the United States to halt additional credits. Imports of soybeans by the republics of the former Soviet Union will be critically dependent on credit availability or other barter arrangements. Credit defaults by the FSU in 1993 served as an indicator of the volatility introduced into global commodity markets as a result of the FSU republics' inability to import without credit.

Average annual growth in the FSU for both soybean and soybean meal imports is expected to remain slow in the near future. However, as economic reforms result in increasing incomes and more economic and political stability, some growth in soybean meal consumption is expected to resume.

Sunflowerseed

U.S. sunflower production is geographically concentrated and, while very important to regional economies, does not command a large share of national cropland. The 1992 Census of Agriculture indicated that 95 percent of sunflower acreage was concentrated in five States: North Dakota, South Dakota, Minnesota, Kansas, and Colorado (app. table 7).

Sunflowers were touted as "one of the most promising growth crops" as the 1970's drew to a close, and U.S. acreage projections of 10 million were not uncommon (Kleingartner, 1988). These projections were based on several advantages that sunflower cultivation offered (particularly to producers in the Northern

Plains): a short growing season, drought tolerance, a developing crushing industry to absorb the product, and its use as a profitable alternative crop in a rotation with small grains.

Sunflower acreage failed to expand as expected in the 1980's, despite the optimistic projections. Acreage significantly dropped in 1980 and ranged between 3.1 and 4.8 million acres through 1985. In 1986, acreage fell sharply and by 1987 was below 2 million acres, where it remained until 1990. The substantial decline in acreage in the 1980's was due in part to the reversal of the very factors that had led to the earlier expansion:

1) Sunflower prices leveled off and then declined as world oilseed and product competition intensified, especially in the European Community;

2) The returns of wheat and barley in the United States increased because of rising Government income supports, making sunflowers a less attractive crop alternative; and

3) The increased yields associated with the new cultivars came with increased production costs, while the continued concentration of sunflower production and lack of rotation increased susceptibility to pest and disease attacks.

Starting in 1991, sunflower acreage again reversed its trend, expanding to 2.7 million acres and by 1994 had reached 3.6 million. The reversal was partially driven by the changes in the 1990 farm legislation that allowed farmers to respond more promptly to market conditions. These acreage increases were also influenced by low wheat returns in the five principal sunflower-producing States during that period.

The outlook for sunflower acreage for the rest of the 1990's is uncertain. The changes in farm policy should continue to allow farmers flexibility to respond to market conditions as in 1994. But the rate of growth of domestic and foreign markets for sunflowerseed and products will be crucial. Reduced competition from foreign producers through reduced EU supplies and robust world consumption of vegetable oils should support some expansion in U.S. sunflower acreage. Whether U.S. export subsidies for sunflower oil are continued will also make a difference.

Farm Characteristics

The 1992 Census of Agriculture recorded 9,914 farms growing sunflowers, with a harvest of roughly 2 million acres. This acreage produced 2.2 billion pounds of seed for a total farm value of $208.8 million. Although 33 States reported sunflower production, five States—North Dakota, South Dakota, Minnesota, Kansas and Colorado—accounted for 93 percent of national production. North Dakota alone accounted for 56 percent of sunflower production.

Cash grains, primarily wheat, barley, corn, and soybeans, dominated crop production in these States. Eighty-four percent of the farms growing sunflowers were classified as cash grain farms in 1992. The 1992 Census of Agriculture surveyed sunflowers as a principal crop in only North Dakota, South Dakota, and Minnesota. Few farms specialize in growing solely sunflowers because of the limited market for sunflower products and agronomic constraints. Rather, sunflowers are rotated with grains and other specialty crops adapted to the region.

Thirty-nine percent of U.S. farms with sunflower acreage harvested fewer than 100 acres, 36 percent harvested between 100 and 249 acres, and 25 percent harvested 250 acres or more (app. table 9). In the two leading States, North and South Dakota, operations tended to be larger, with 26-29 percent harvesting more than 250 acres.

Sunflowerseed and Sunflowerseed Product Demand

The demand for oil-type sunflowerseed is primarily derived from the demand for various end products. The market for seed is complicated by the two distinct seed classes: oil-type and confection. While the two types are substitutable to a certain extent, each holds a comparative advantage in a different end market. The demand for sunflowerseed and its end products is also sensitive to macroeconomic factors, including changes in income levels and interest rates that affect consumer demand and operating costs, as well as Government policies and exchange rates that affect domestic production and trade patterns.

Oil-Type Sunflowerseed

Sunflowerseed demand includes domestic processing for oil and meal production as well as demand for exported seed to be crushed abroad. The price paid for seed and the prices received for oil and meal determine the profitability of crushing operations. The profitability of processing (margin) changes as the demands for sunflowerseed oil and meal expand or contract.

Meal and hulls represent larger weight components of oilseed than of confectionery sunflowers. However,

because of the higher prices, oil dominates in terms of overall seed value. For example, between 1978 and 1993, oil content ranged between 37 and 42 percent of the seed crushed, while meal content ranged between 50 and 59 percent. During this same period, oil accounted for an average 79 percent of the value of the products.

Sunflowerseed oil and meal markets are complex, and the resulting prices necessary to clear these markets are closely tied to vegetable oil and animal feeds markets. This market similarity stems from the high degree of substitutability found among the various oils and meals. Foreign trade patterns and public policy choices that influence domestic markets also affect sunflowerseed oil, meal, and resulting seed demand.

For the 1994/95 marketing year, USDA estimates total supply of oil-type sunflowerseed at 4.3 billion pounds, up 92 percent from 1993/94. Exports are expected to reach 300 million pounds, up 280 million from 1993/94. Crush is expected to climb to a new record of 2.3 billion pounds, up 59 percent from the previous year. However, carryover stocks are forecast at a record 920 million pounds.

The expected record crush will result in a 426,000-metric-ton production of sunflowerseed oil in 1994/95, up 62 percent from 1993/94. Domestic demand is expected to increase to 91,000 metric tons (up 54 percent), while exports of sunflowerseed oil are expected to total 320,000 metric tons, more than 57 percent higher than last season (app. table 12).

Confection Sunflowerseed

Confection sunflowerseed differs from oil-type sunflowerseed not only in its genetic characteristics, but also in the markets that drive seed demand. The larger seed size and a loose hull of the confection sunflowerseed facilitate cracking and make it well suited to the direct food uses market. Confection sunflowerseeds have also made significant inroads into the breads and baked goods markets, both domestically and abroad. In these markets, confection sunflowerseeds compete with other nut crops such as peanuts, almonds, walnuts, cashews, and grains used in the production of multi-grain breads. Confections also compete for discretionary consumer income with other snack foods including potato and corn chips, dried fruits, cheese products, and candies.

Data pertaining to the demand for confection sunflowerseed are limited. USDA estimates total demand for confection sunflowerseed (export and domestic uses including use for bird food and seed) in the 1994/95 marketing year at about 579 million pounds, up from an estimated 452 million in 1993/94.

Global Market for Sunflowerseed and Products

World sunflowerseed production grew more than 4 percent annually since 1972 and averaged 10 percent of global oilseed production between 1988 and 1993. Sunflowerseed production ranks fifth in world oilseed production, behind soybeans, cottonseed, peanuts, and rapeseed.

Most of the growth of sunflowerseed production since 1972 was concentrated in the major producing areas of the FSU, the EU, and Argentina. These three regions accounted for 62 percent of world sunflowerseed production over the 1985-93 period. Other major producers include the United States, China, Turkey, Hungary, and Romania. The U.S. share of world sunflowerseed production peaked in 1979 at 20 percent. Over the past two decades, rising production in other producing countries has reduced this share to an average of 5 percent. Growth in global output of sunflowerseed is expected to slow through the year 2000 to 3 percent per year. Changing policies in major producing countries and the relative prices of competing commodities are expected to constrain growth.

International factors affecting the competitiveness of U.S. exports of sunflowerseed and products include the production and trade policies of foreign competitors and importers, availabilities of other oils and their relative prices, and international trade agreements.

The export market has historically been very important for the U.S. sunflowerseed industry, with exports constituting almost 70 percent of production in the 1978-82 period. This ratio dropped precipitously after the early 1980's and has averaged 10 percent since 1988. Approximately two-thirds of U.S. sunflowerseed exports are destined to the EU, particularly Spain and Germany. However, changing policies in the EU have reduced demand for imported sunflowerseed. Increasing supplies from Argentina in the 1980's have caused significant decreases in U.S. exports since the mid-1980's.

Foreign Policy Developments

Currently there is very little support, either through domestic policies or export subsidies, for competitor exports of sunflowerseed or sunflowerseed oil. The EU's surge in sunflowerseed production over the

1980's was stimulated through support programs aimed at increasing farm incomes and reducing dependence on imported oilseeds.

EU policy reforms have resulted in a decline in EU sunflowerseed and sunflowerseed oil production since 1990. In 1993, for the first year since 1985, the EU resumed its status as a net importer of sunflowerseed oil. This steady decline in production is likely to be institutionalized through provisions of the U.S.-EU oilseed agreement that limit oilseeds area payments to a mandated level. The base area for rapeseed, sunflowerseed, and soybeans is set at 5.128 million hectares for the EU-12 beginning in 1995/96. Consequently, EU import demand for sunflowerseed is likely to increase from the low levels of the 1980's.

The major exporter of sunflowerseed, Argentina, has historically taxed its agricultural exports. However, a system of differential export taxes has supported the production of value-added oilseed products (meal and oil) since the early 1980's and is likely to continue. The agricultural sector, apart from the benefits passed on to the crushing industry through the differential taxes, received no support from the government. Argentine sunflowerseed production has experienced little growth over the 1990's, and the outlook for significant expansion in sunflowerseed production is likely to be constrained by increased wheat area over the next decade.

U.S. Export Policies

U.S. sunflowerseed and product exports have become increasingly dependent on government-assisted programs, such as credit guarantees, export subsidies, and food aid. Export programs that directly affect the sunflowerseed industry include the *Export Credit Guarantee Program* (GSM-102/103) and the *Sunflowerseed Oil Assistance Program (SOAP).*

Exports of sunflowerseed and its products have been promoted through the use of short-term credit (up to 3 years, GSM-102) and its longer term counterpart GSM-103 (3-10 years). In 1985, GSM sales of sunflowerseed and oil reached a peak, with 68 percent of sunflowerseed exports and 75 percent of oil exports facilitated under the program.

Since the inception of the SOAP program in 1988, exports of subsidized sunflowerseed oil shifted from EEP to SOAP, with isolated EEP sales of sunflowerseed oil registered in 1991 and 1992. SOAP is specifically designed to allow U.S. exporters of sunflowerseed to match world export prices for sunflowerseed oil in targeted markets. In fiscal 1992 and 1993, over 80 percent of U.S. sunflowerseed oil exports were assisted by SOAP, with average bonuses ranging from $87 per metric ton in FY 1992 to $127 in FY 1993. The major recipients of SOAP sales in FY 1993 were Algeria, Mexico, and Egypt while the major commercial markets were Japan and the EU.

Trends and Outlook for Sunflowerseed Trade

World trade in sunflowerseed accounts for only a small portion of world sunflowerseed production, averaging only 9 percent since 1988. Trade in sunflowerseed has been increasingly dominated by the EU and the FSU as trade between these two regions boosted their combined global market share from 15 percent to 65 percent between 1975 and 1985. A reversal of the strong EU production growth experienced in the 1980's is likely to cut the EU's share of world exports in half from the peak of 75 percent in 1988.

Exports from Argentina, the other major foreign exporter, accounted for about 13 percent of world trade in recent years. This share has grown from the 1975-85 average of 6 percent. The United States accounted for about 9 percent of world sunflowerseed trade over the past decade.

The EU remains the major import market for sunflowerseed, accounting for nearly 80 percent of total trade in sunflowerseed. A slowdown in EU domestic production through the year 2000 offers opportunities for expansion in sunflowerseed imports. Mexico, despite a smaller share of world imports from the 1975-85 period, continues to be a major importer, accounting for 11 percent of global imports between 1985 and 1993. The implementation of NAFTA is expected to increase Mexican imports.

Trends in Sunflowerseed Oil Trade

Sunflowerseed oil is the fourth largest edible oil produced and consumed in the world, accounting for about 12 percent of total vegetable oil production and consumption since 1990. Sunflowerseed oil trade has averaged about one-third of total production since the mid-1980's. Buoyed by strong production growth over the 1980's, exports of sunflowerseed oil grew by 9 percent over the decade. Adverse weather conditions in major producing countries in the early 1990's and policy reforms in the EU and the FSU led to a 10-percent drop in exports.

Argentina dominates the export market for sunflowerseed oil, accounting for approximately 39 percent of world exports. Domestic policies in the EU contrib-

uted to the doubling of EU sunflowerseed production over the 1980's, turning the EU into a net exporter of sunflowerseed oil and expanding its share of the export market from 22 to 26 percent. In Eastern Europe, however, increased domestic consumption of sunflowerseed oil eroded its market share.

U.S. Market Share and the Outlook for U.S. Exports

A contraction in U.S. sunflowerseed production over the 1980's and strong export supplies from competitors such as Argentina have led to a significant decline in the U.S. share of world sunflowerseed trade. U.S. market share, which averaged near 70 percent in the 1970's, dropped precipitously to average 6 percent since 1990. A projected slowdown in production growth in the EU, however, has the potential to reverse this declining trend. U.S. exports of sunflowerseed oil are important to the domestic industry, constituting about 72 percent of total oil production since 1985. U.S. exports, however, have averaged 9 percent of world trade in sunflowerseed oil since 1985. The major markets for U.S. sunflowerseed oil include Mexico, Algeria, the EU, and Egypt, together accounting for about three-quarters of U.S. exports over 1988-93.

Income growth in many of these markets and a slowdown in production growth in the EU are likely to increase import demand for sunflowerseed oil through this decade. U.S. sunflowerseed oil exports and market share are expected to increase as growth in competitor export supplies slows over the next 10 years.

Rapeseed and Canola

Canola is the name given to the seed, oil, and meal derived from rapeseed cultivars that are low in erucic acid and glucosinolates. These compounds present potential health risks to humans and reduce the palatability and nutritional value as a feed. While many parts of the world continue to produce high-erucic-acid varieties for human consumption, the so-called "double low" varieties now dominate production in Canada and throughout western Europe. Worldwide production of all rapeseed has risen rapidly over the past two decades and rapeseed now ranks third behind soybeans and cottonseed.

A member of the mustard family, rapeseed cultivation is suitable to colder climates in North America, northern Europe, the former Soviet Union, and parts of Asia. Prior to 1985, all U.S. production went toward specialized industrial uses. Accordingly, acreage remained small and was concentrated in areas of the Northern Plains, Northwest, and parts of the southern Corn Belt. In 1982, only 65 farms reported harvested acreage of rapeseed, totaling 6,382 acres. Roughly 95 percent of the production acreage was located in just three States: North Dakota, Montana, and Kentucky.

In January of 1985, the Food and Drug Administration granted GRAS (Generally Recognized As Safe) status for low-erucic-acid rapeseed (LEAR) products. Since that time, interest in canola has grown rapidly in the United States. Interest has been fueled further by implied health benefits associated with the lowest saturated fat content among all major vegetable oils. Since 1985, U.S. rapeseed area and production have significantly expanded. The 1992 Census of Agriculture indicated that 1,181 farms reported harvesting 89,777 acres of rapeseed (82,098 acres were canola). North Dakota, Idaho, Washington, and Minnesota accounted for 58 percent of the total acreage, while the remainder was distributed among 26 States.

Rapeseed has also made substantial inroads into the world oilseed and products trade. It ranks second in terms of world oilseed trade, with Canada and France accounting for most of the exports. Rapeseed plays a less dominant role in oilseed products trade. Palm and soybean oil continue to dominate world oil trade, while soybean meal still commands the largest share of the protein meal market.

However, competitively priced rapeseed products continue to gain market share. Favorable oilseed policies in the EU and, more recently, Canada have allowed rapeseed oil to capture 10 percent of world vegetable oil trade, more than double its share of the late 1970's. Rapeseed meal trade has also expanded, accounting for roughly 7 percent of world meal trade in 1993. Canola in the United States, however, remains a minor crop, dwarfed by traditional crops such as corn, wheat, and its principal competitor, soybeans.

Despite growing interest, there is no solid consensus on how the role of canola and its principal byproduct, canola oil, will evolve in the United States. Views range from a role as a niche crop for the specialty oils market to the next big cash crop for U.S. farmers, able to compete head-to-head in the U.S. vegetable oil and protein meal complex with soybeans. The ability of canola and its products to capture a larger share of U.S. oilseeds markets and farm resources will depend on a number of factors. First, does a market for the products exist, and, if so, what are the factors driving the demand for these products and products that compete with canola for market share? Second, if the

demand exists, can the crop be produced profitably enough to attract resources away from other crops and land uses? One obstacle to greater U.S. production is that few pesticides have been registered with EPA to permit their use on canola.

The demand for canola seed is derived mainly from its use as an input in canola oil production and secondarily as an input in meal production. Canola meal is a less valuable livestock feed than soybean meal, because it is lower in protein and has a higher roughage content.

USDA estimates total supply of canola seed for the 1994/95 marketing year at 1.5 billion pounds, up 48 percent from last season. Despite the 77-percent year-to-year increase in domestic production, from 252 million pounds to 447 million, imports of Canadian canola seed still represent 65 percent of total U.S. supplies (app. table 14).

The demand for canola seed in 1994/95 is expected to reach 1.4 billion pounds, 51 percent higher than in 1993/94. Crush, the most important component of the demand, is expected to set a new record at around 1.3 billion pounds. Exports in 1994/95 are forecast at 110 million pounds.

The record crush is expected to produce 481 million pounds of canola oil, a level far below the 1994/95 total demand of 1.4 billion pounds, resulting in 963 million pounds of canola oil being imported, mostly from Canada (app. table 15). Greater canola oil imports have largely satisfied the accelerating demand for the last 5 years, as consumption has outpaced domestic production.

Flaxseed

Flaxseed, the raw material from which linseed oil is obtained, is the seed of the flax plant. The early colonists brought flaxseed into this country to make flax fiber, which was to be spun and woven into linen cloth. Thus, flax was originally grown in the United States as a fiber crop. The invention of the cotton gin in 1793 caused the demand for flax fiber to decline and more flax was grown for flaxseed, instead. Flaxseed is classified in the United States as an oilseed crop along with cottonseed, peanuts, and soybeans. While oils from these other oilseeds are classified as "non-drying" oils, linseed oil is classified as a "drying oil." The "drying property" of a vegetable oil is its ability to absorb oxygen when exposed to the air. This attribute made linseed oil the principal vehicle for protective coatings and other allied manufactured products, resulting in the cultivation of several million acres of flaxseed in the early 20th century.

After World War I, new chemicals, new materials, and new techniques were developed in the protective coating industry that began replacing linseed oil as the only input. The largest losses of linseed oil markets occurred as a result of the development of vinyl floor coverings to replace linoleum and latex interior paints as a direct replacement for linseed oil-based paints. The dramatic decline in linseed oil demand resulted in a huge decline in planted acreage of flaxseed (table 13).

Today, U.S. flaxseed production is centered in Minnesota, South Dakota, and North Dakota. USDA

Table 13—Flaxseed acreage planted, harvested, yield, and production, 1965-94

Year	Planted	Harvested	Yield	Production
	- -1,000 acres - -		*Bu./ acre*	*1,000 bushels*
1965	2,868	2,775	12.8	35,402
1966	2,679	2,576	9.1	23,390
1967	2,061	1,976	10.1	20,036
1968	2,177	2,092	12.9	26,983
1969	2,661	2,605	13.4	34,929
1970	2,950	2,836	10.4	29,416
1971	1,627	1,545	11.8	18,198
1972	1,189	1,149	12.1	13,883
1973	1,749	1,700	9.7	16,408
1974	1,742	1,659	8.5	14,083
1975	1,621	1,511	10.3	15,553
1976	1,045	955	7.9	7,580
1977	1,330	1,239	11.5	14,280
1978	710	687	12.5	8,614
1979	922	878	13.7	12,014
1980	759	663	11.7	7,728
1981	605	577	12.6	7,289
1982	780	735	14.0	10,278
1983	605	580	11.9	6,903
1984	555	538	13.1	7,022
1985	620	584	14.2	8,293
1986	720	683	16.9	11,538
1987	470	463	16.1	7,444
1988	275	226	7.1	1,615
1989	195	163	7.5	1,215
1990	260	253	15.1	3,812
1991	356	342	18.1	6,200
1992	171	165	19.9	3,288
1993	206	191	18.2	3,480
1994	178	171	17.1	2,922

Source: U.S. Department of Agriculture, National Agricultural Statistics Service, Crop Production, annual and monthly issues, 1962-95.