Chapter 2

An Overview of the U.S. Grain System

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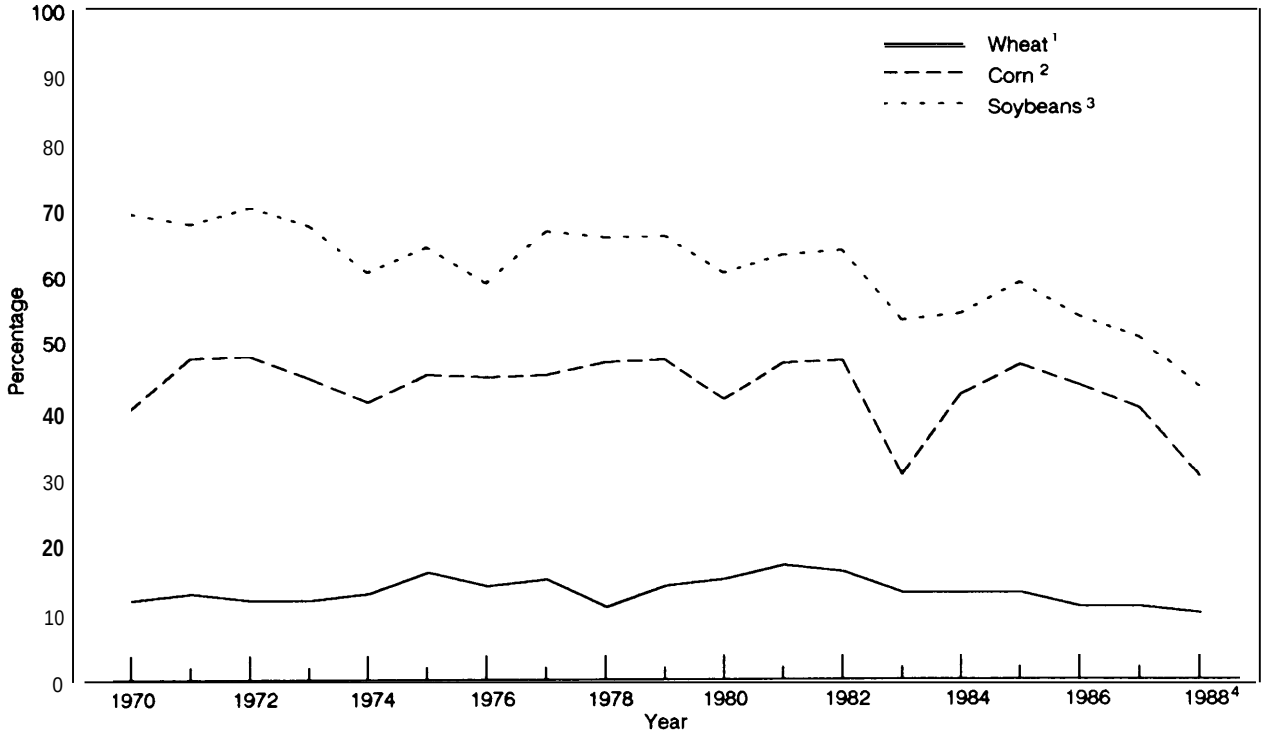
Chapter 2

An Overview of the U.S. Grain System

The United States grain industry has many characteristics that make it a formidable competitor in world markets. First, it has the capability to meet almost any demand. During the 1970s, when conditions caused a dramatic increase in demand, the Nation showed it had the productive and distributional capability to meet that demand. Second, the United States can produce almost any type of grain. Of the major grains, it is the world's largest producer of corn and soybeans and the fourth largest producer of wheat (figure 2-I). Third, a buyer can purchase nearly any type of grain at any time of the year from the United States. For many other countries this is not possible. Fourth, the Nation has the capability to move grain from farm to terminal to overseas buyer very efficiently. This is because of the extensive interstate highway system, rail system, and waterways. In addition, its high-volume, high-speed elevator facilities—both inland and export—are as efficient as any in the world.

Figure 2-1. -U.S. Share of World Wheat, Corn, and Soybean Production, 1970-88 (percentage)



SOURCES:

1 1970–83: s Evans, "wheat: Background for 1965 Farm Legislation," Agriculture Information Bulletin No 467, U S Department of Agriculture (USDA), Economic Research Service (ERS), Washington, DC, 1964,
1984-88: USDA, Foreign Agricultural Service (FAS), "World Gram Situation and Outlook," Circular Series FG 10-88, Washington, DC, October 1988

2 1970–81: USDA, ERS, 'Corn, Background for 1965 Farm Legislation," Information Bulletin No 471, Washington, DC 1964,
1982-88: USDA, FAS, 'World Grain Situation and Outlook," Circular Series FG 10 66, Washington, DC, October 1966

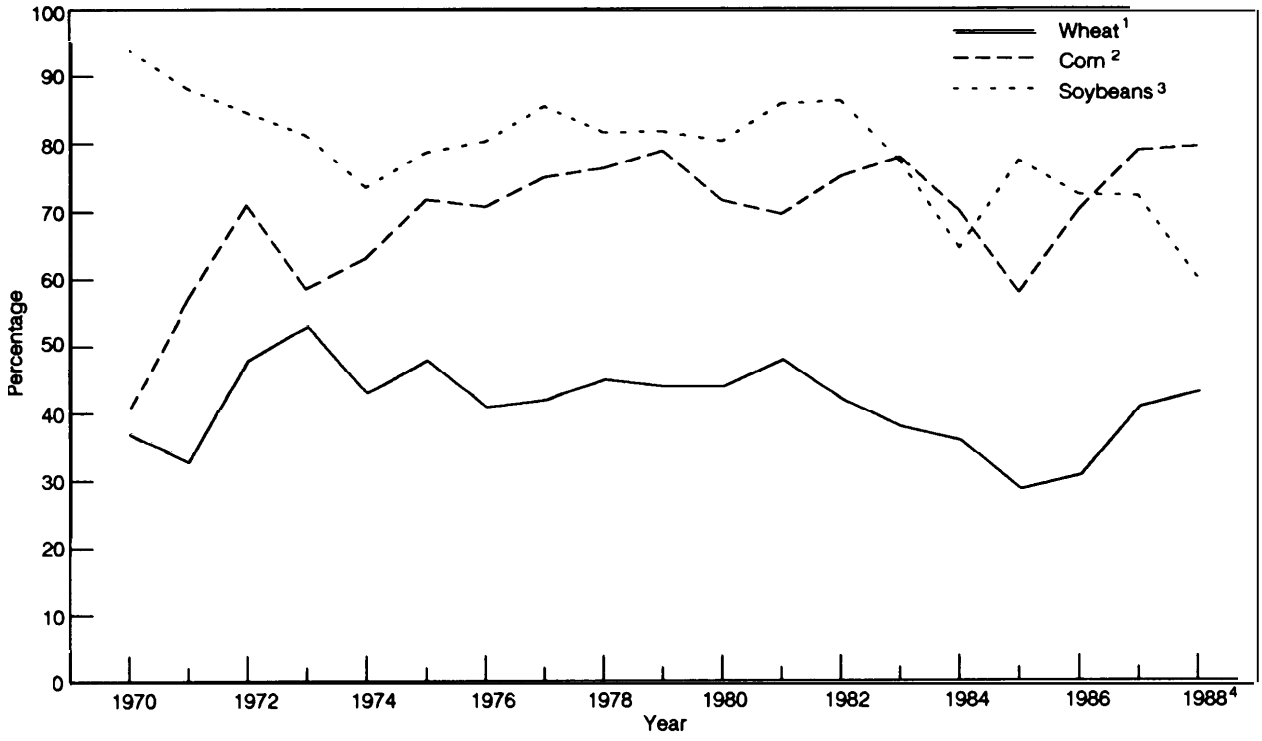
3 1970–81: USDA, ERS, 'Soybeans, Background for 1965 Farm Legislation," Agriculture Information Bulletin No 472, Washington, DC, 1964,
1982-88: USDA, FAS, "World Oilseed Situation and Market Highlights," Circular Series FOP 10-66, Washington, DC, October 1966

4 As of October 1966

Notwithstanding all these strengths, the ability of the United States to compete in world markets has been called into question recently. Such a question would have seemed absurd 10 years ago when the value and volume of U.S. grain and oilseed exports increased enormously. The U.S. share of world markets seemed secure (figure 2-2); the value of agricultural exports more than doubled in real terms between 1970 and 1980, with the real value of U.S. grain exports more than tripling. Agricultural exports were considered the bright spot in the generally poor U.S. trade performance across all economic sectors. In 1981, however, wheat, corn, and soybean exports fell sharply while slow but consistent growth in imports of a large variety of agricultural products continued unabated. By 1986, the Nation's export and net trade position had almost returned to 1970 levels. The U.S. agriculture industry confronted the possibility that it might face the kind of trade problems that had plagued the steel, automobile, and semiconductor industries. One congressional attempt to respond to this situation was the Grain Quality Improvement Act of 1986.

A number of factors have been listed by trade experts as causing the decline in agricultural exports, including global recession, the strong U.S. dollar, high price-support levels, European Economic Community restrictions, and increased world productive capacity. However, another factor emerging is grain quality and

Figure 2-2. -U.S. Export Market Shares In Wheat, Corn, and Soybeans, 1970-88 (percentage)



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1 **1970–83:** S Evans, "Wheat: Background for 1985 Farm Legislation," Agriculture Information Bulletin No 467, U S Department of Agriculture (USDA), Economic Research Service (ERS), Washington, DC, 1964;
1984-U: USDA, Foreign Agricultural Service (FAS), "World Gram Situation and Outlook," Circular series FG 10-66, Washington, DC, October 1966

2 **1970–81:** USDA, ERS, "Corn, Background for 1985 Farm Legislation," information Bulletin No 471, Washington, DC 1984;
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3 **1970–81:** USDA, ERS, "Soybeans, Background for 1985 Farm Legislation," Agriculture Information Bulletin No 472, Washington, DC, 1964;
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its use as a competitive tool in international markets. The factors listed above are considered the major contributors to the decline in world market share. But as the dollar weakens and lower price-support levels take effect, allowing U.S. exports to become more price-competitive, opportunities to increase exports may be hampered by foreign buyers' concerns about U.S. grain quality.

Importers of U.S. grain have become more vocal in their concern about quality. Formal complaints made by buyers to the U.S. Department of Agriculture (USDA) have increased yearly. In 1987 over 60 complaints concerning quality were received at USDA. This number is a conservative estimate of the true concern since the amount of paperwork involved discourages the filing of complaints. Examples of specific complaints include: excessive amounts of material other than grain in the shipment; quality attributes, such as wheat protein, not meeting contract specifications; grain (mainly corn and soybeans) arriving out of condition, e.g., moldy or infested; and grain arriving in a broken or cracked condition.

This report focuses on the enhancement of grain quality, To put that issue in perspective, it is important to understand how the U.S. grain system operates. The following sections provide an overview of grain production, end uses, export markets, grain flow, Government programs, and quality control, which are described in the rest of this assessment. The chapter ends with a discussion of the quality issue and a definition of quality.

GRAIN PRODUCTION

Production trends in the United States from 1971 to 1986 are shown in table 2-1. Annual wheat production averaged 1.7 billion bushels during the first 4 years of this period. By 1979, yearly production had increased to 2.1 billion bushels, and it peaked at 2.8 billion bushels by 1981. Overall, wheat production has increased 29 percent since 1971.

From 1971 to 1975, corn production averaged 5.5 billion bushels per year. Production increased to 7.9 billion bushels by 1979. In 1983, corn production was drastically reduced as *a* result of the payment-in-kind program. But in 1985, it peaked at 8.9 billion bushels. However, in 1988 corn production dropped to only 4.5 billion bushels because of the severe drought. Corn production overall has increased 46 percent since 1971.

Yearly soybean production averaged 1.3 billion bushels per year during the years 1971 to 1976; output peaked at 2.3 billion bushels in 1979, and stayed around 2.0 billion bushels by 1986. But it was reduced to 1.5 billion bushels in 1988 because of the drought. Overall, soybean production has increased 71 percent since 1971.

Table 2-1.—U.S. Wheat, Corn, and Soybean Production, 1971-88 (millions of bushels)

Year	Wheat	Soybeans	Corn
1971	1,618.6	1,176.1	5,641.0
1972	1,546.2	1,270.6	5,573.0
1973	1,170.8	1,547.5	5,647.0
1974	1,781.9	1,216.3	4,701.4
1975	2,126.9	1,547.4	5,829.0
1976	2,148.8	1,287.6	6,266.4
1977	2,045.0	1,767.0	6,425.5
1978	1,775.5	1,869.0	7,081.8
1979	2,134.1	2,268,0	7,938.8
1980	2,380.9	1,798.0	6,644.8
1981	2,785.4	1,989.0	8,201.6
1982	2,765.0	2,190.0	8,235.1
1983	2,419.8	1,636.0	4,174.7
1984	2,594.8	1,861.0	7,674.0
1985	2,425.1	2,099.0	8,876.7
1986	2,086.8	1,940.0	8,252.8
1987	2,105.0	1,905.0	7,064.0
1988*	1,821 .0	1,472.0	4,462.0

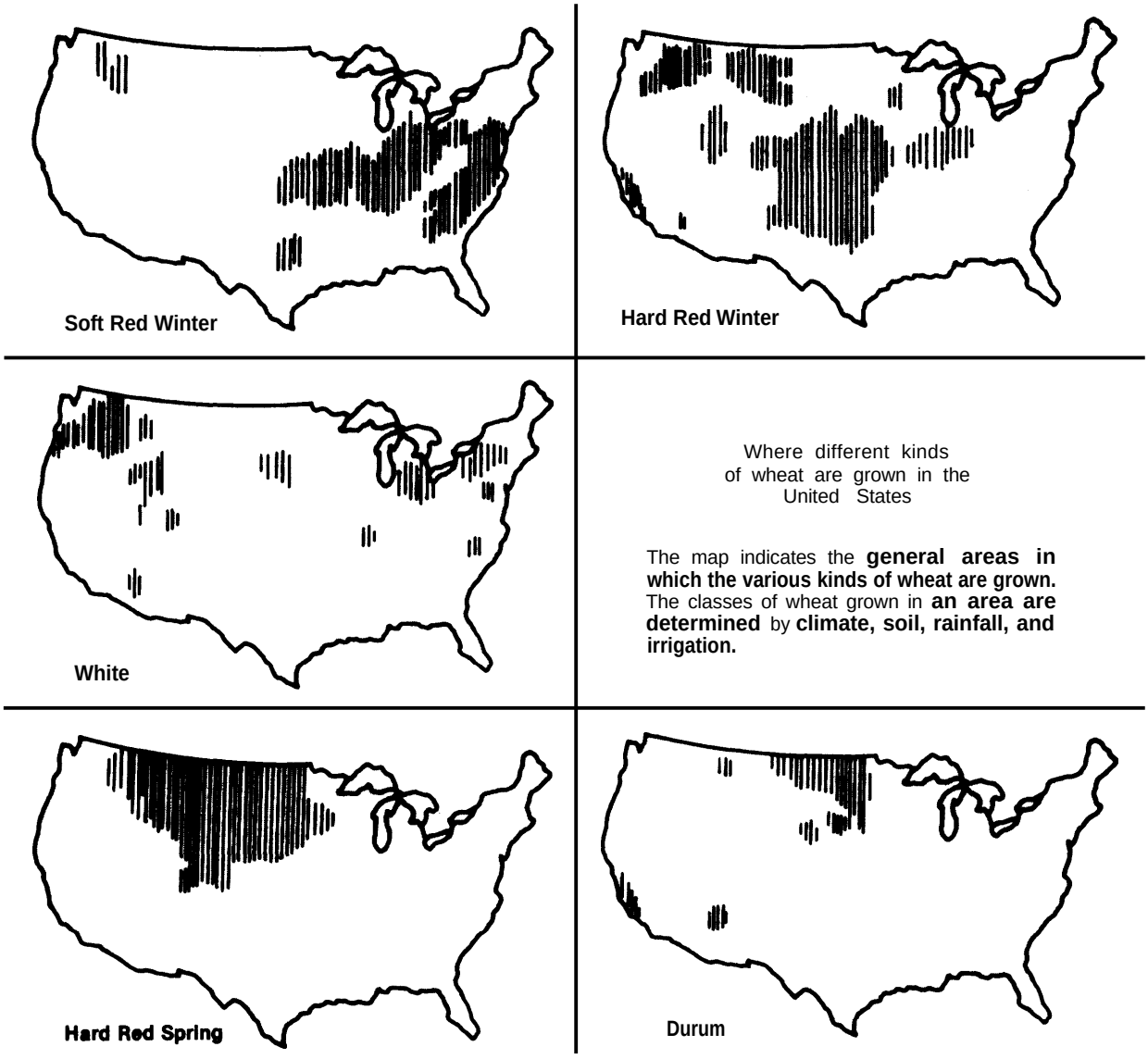
'Preliminary

SOURCE: U S. Department of Agriculture, "Crop Production," Agricultural Statistics Board, National Agricultural Statistics Service CrPr 2-2, Washington, DC, various issues.

Wheat

Figure 2-3 shows the general areas where various wheat types are grown. Forty-two States produce various wheat types. However, almost 42 percent is produced in just five States:

Figure 2-3. --Wheat-Producing Areas of the United States



SOURCE: Wheat Flour Institute, "From Wheat to Flour," revised cd., Washington, DC, 1981.

Kansas, Oklahoma, Texas, Nebraska, and Colorado. These five produce Hard Red Winter wheat—the major type grown in the United States.

About one-fourth of the wheat produced in the United States is grown in North and South Dakota, Minnesota, and Montana. These States produce Hard Red Spring wheat. Of the several other wheat types produced, Durum wheat is grown mainly in North Dakota and Montana, White wheat is grown mainly in the Pacific Northwest, and Soft Red Winter wheat is grown from Missouri to Ohio and in the Atlantic States.

Corn

Corn is produced in 47 States. The six Corn Belt States—Iowa, Illinois, Indiana, Nebraska,

Minnesota, and Ohio—produced about 70 percent of the 1985 corn crop. Historically these six have been the dominant corn-producing States. Corn production in recent years, however, has increased in other parts of the country. This has been the result of new, short-season hybrid seed corn that has increased yields in Northern States like North Dakota and New York, and of Government programs that have made corn production profitable in States with relatively high production costs.

Soybeans

Soybeans are produced in 29 States. Six account for almost two-thirds of the output: Illinois, Iowa, Indiana, Missouri, Ohio, and Minnesota. In fact, Illinois and Iowa accounted for 33 percent of the total 1985 crop and were the dominant producers.

UTILIZATION

Each grain has multiple uses and is important in world markets. In this section the various uses of each will be discussed as well as the magnitude of the dependence on export markets.

Wheat

Wheat is used for domestic food consumption, export, animal feed, and seed (table 2-2). The proportion used for domestic purposes has fluctuated between 32 and 53 percent over the past 15 years. Wheat is very dependent on the export market. The export market has grown since 1971, and by the early 1980s as much as **68** percent of U.S. wheat was exported. The export market share has declined since then to less than 50 percent of total wheat use.

Almost all wheat, other than that fed directly to livestock, is milled into flour for producing a variety of bakery products for human consumption. Wheat is unique in that it is the only cereal grain with sufficient gluten content to make a loaf of bread without being mixed with another grain.

Corn

The major use for corn is domestic animal feed, accounting for well over half the corn con-

Table 2-2.— U.S. Utilization of Wheat by Type of Use, 1971-88 (million bushels and percentage)[a]

Year	Food	Seed	Animal feed	Total domestic	Domestic share (percent)	Exports	Export share (percent)
1971-72	523.7	63.2	262.4	849.3	58.2	609.8	41.8
1972 -73	531.8	67.4	199.8	799.0	41.3	1,135.0	58.7
1973 -74	544.3	84.1	125.1	753.5	56.1	1,217.0	43.9
1974 -75	545.0	92.0	34.9	671.9	39.7	1,018,5	60.3
1975 -76	588.6	99.0	38.3	725.9	38.2	1,172.9	61.8
1976 -77	588.0	92.0	74.4	754.4	44.2	949.5	55.8
1977 -78	586.5	80.0	192.5	859.0	43.3	1,123,9	56.7
1978-79	592.4	87.0	157.6	837.0	41.2	1,194,1	58.8
1979-80	596.1	101.0	86.0	783.1	36.2	1,375,2	63.8
1980 -81	610.5	113.0	59.0	782.5	34.1	1,513,8	65.9
1981 -82	602.4	110.0	134.8	847.2	32.4	1,770.7	67.6
1982 -83	616.4	97.0	194.8	908.2	37.6	1,508,7	62.4
1983-84	642.6	100.0	369.1	1,111.7	43.8	1,428.6	56.2
1984 -85	651.0	98.0	404.5	1,153.5	44.7	1,424.1	55.3
1985-86	678.1	93.0	273.5	1,044,6	53.3	915.4	46.7
1986 -87	696.0	84.0	413.3	1,193,3	54.3	1,003,5	45.7
1987-88[b]	719.0	85.0	280.1	1,084.2	40.5	1,592.1	59.5

[a] Differences between utilization and production are attributable to imports
[b] Preliminary

SOURCE U S Department of Agriculture, "Wheat Situation and Outlook Report, " Economic Research Service. Washington, DC various issues

sumed in the United States (table 2-3). Feed use has fluctuated with prices and livestock inventory. Other domestic uses include food/industrial use and seed. Industrial use has shown steady growth since 1971. Total domestic corn usage has accounted for 70 to 85 percent of usage over the past 15 years. Corn is not as dependent as wheat on world markets, but as much as 30 percent of total usage is exported in some years.

Feed grains, which include corn, are characterized as high-energy grains due to their relatively high levels of nitrogen-free extract (principally starch) and low levels of crude fiber (4). Nearly all feed grains are highly palatable to livestock. Corn is the leader in the amount of energy contained. However, several byproducts from corn used by food manufacturers are also available for animal feed. These include such products as corn gluten feed and meal, Brewer's dried grains, and distiller's dried grains.

Corn is prepared for human consumption and industrial use by dry and wet mill processing. Dry milling is the process by which corn is separated into components of hulls, germs, and endosperm. Two processes are used: tempering-degerming and alkaline dry milling. These produce flaking grits for breakfast cereals, baking, and the snack food industries.

More than half the corn starch manufactured from the wet milling process is converted into corn syrups and corn sugar. Corn starches and sugars are used for human foods, beverages, industrial products, and livestock feeds. Corn syrup is used in human foods, beverages, and industrial products. Crude corn oil, which is extracted during starch recovery, is used for human food, industrial products, and animal feed. The water used to soak the corn, commonly referred to as steepwater, is used in pharmaceuticals and liquid animal feed.

Soybeans

Soybeans are processed for domestic food and feed consumption, used for seed, and exported. Domestic processing is the most important use of soybeans and has increased steadily over the past 15 years (table 2-4). Domestic soybean utilization has accounted for approximately 60 percent of total usage, while the export market has accounted for about percent.

Soybeans are primarily used for oil extraction. The residuals from this process are toasted and ground into a high-protein meal for use as a supplement in animal feed. Other soybean uses include lecithin, soy flour, and soy grits. Soybean meal usage, like corn, has increased

Table 2-3.—U.S. Utilization of Corn by Type of Use, 1971-88 (million bushels and percentage)[a]

Year	Food, alcohol, and industrial	Seed	Animal feed	Total domestic	Domestic share (percent)	Exports	Export share (percent)
1971 -72	394.0	15.0	3,978.0	4,387	84.8	786.0	15.2
1972-73	407.0	16.0	4,310.0	4,733	79.2	1,243.0	20.8
1973-74	417.0	18.0	4,265.0	4,700	79.8	1,188.0	20,2
1974 -75	432.6	18.8	3,225.6	3,677	76.2	1,148.5	23.8
1975-76	469.9	20.2	3,591.6	4,081.7	70.5	1,711.4	29.5
1976-77	493.3	19.8	3,586.6	4,099.7	70.9	1,684.2	29.1
1977 -78	532.9	18.0	3,709.5	4,260.4	68.6	1,947.8	31.4
1978-79	557.0	18.0	4,198.1	4,773.1	69.1	2,133.1	30.9
1979-80	655.1	20.0	4,518.6	5,193.7	68.1	2,432.6	31.9
1980-81	715.1	20.2	4,139.0	4,874.3	67.4	2,355.2	32.6
1981 -82	792.1	19.4	4,276.0	5,087.5	72.1	1,966.9	27.9
1982-83	880.3	14.5	4,520.7	5,415.5	74.7	1,833.8	25.3
1983-84	956.0	19,1	3,817.6	4,792.7	71.6	1,901.5	28.4
1984 -85	1,070.0	21.2	4,079.0	5,170.2	73.5	1,865.4	26.5
1985-86	1,140.0	19.5	4,095.3	5,254.8	80.9	1,241.2	19.1
1986-87	1,175.0	16.7	4,713.7	5,905.4	79.7	1,504.4	20.3
1987 -88	1,207.0	17.0	4,649.7	5,873.7	77.3	1,725.0	22.7

[a]Differences between utilization and production are attributable to imports.

SOURCE: U.S. Department of Agriculture, "Feed Situation and Outlook, " Economic Research Service, Washington, DC, various issues

Table 2-4.—U.S. Utilization of Soybeans by Type of Use, 1971-88 (million bushels and percentage)[a]

Year	Domestic processing	Seed, feed, and residual	Total domestic	Domestic share (percent)	Exports	Export share (percent)
1971	720	65	785	65.3	417	34.7
1972	722	82	804	62.7	479	37,3
1973	821	75	896	62.4	539	37.6
1974	701	79	780	64.9	421	35.1
1975	865	71	936	62.8	555	37.2
1976	790	76	866	60.6	564	39.4
1977	927	82	1,009	59.0	700	41.0
1978	1,018	99	1,117	60.2	739	39.8
1979	1,123	85	1,208	58.0	875	42.0
1980	1,020	99	1,119	60.7	724	39.3
1981	1,030	89	1,119	54.6	929	45.4
1982	1,108	86	1,194	56.9	905	43.1
1983	983	79	1,062	58.8	743	41.2
1984	1,030	93	1,123	65.3	598	34.7
1985	1,053	86	1,139	60.6	740	39.4
1986	1,179	104	1,283	62.9	757	37.1
1987	1,170	96	1,266	61.7	785	38.3
1988[b]	1,075	95	1,170	65.2	625	34.8

[a]Differences between utilization and production are attributable to imports
[b]Preliminary

SOURCE US Department of Agriculture, "Oil Crops Situation and Outlook Report," Economic Research Service, Washington, DC, various issues

relative to livestock inventory. Overall, soybean meal usage has increased 49 percent since 1970.

Export Markets

The United States is quite dependent on world markets, which are constantly changing in response to new relationships between buyers and sellers.

Wheat exports increased dramatically in 1972 and from 1976 to 1982. Overall, wheat exports increased about 190 percent during the decade from 1971 to 1981 and have declined by almost 50 percent since then,

The markets for U.S. wheat have shifted over time. The major importers in 1970 were India, Western Hemisphere countries, Japan, the European Community (EC), and South Korea (table 2-5) By 1985, exports to India and the EC had declined sharply. The major importers were Western Hemisphere countries and Japan (same markets) and the African countries (new markets). During this time the Soviet Union (U.S.S.R) was a sporadic buyer–but a large one.

Corn exports increased dramatically from 1971 to 1981, During that time exports increased by 200 percent, but since then they have declined by 47 percent. In 1970, the largest importers of U.S. corn were the EC and Japan (table 2-6). By 1985, the EC share had dropped to 10 percent and the largest importers were Japan and the U.S.S.R. Other areas that had steady growth during this time were theWestern Hemisphere, the Middle East countries, and South Korea.

The growth of soybean export markets followed the same path as wheat and corn. During the 1971-81 period, U.S. soybean exports increased 123 percent. Since then exports have declined by 25 percent. Compared with wheat and corn, the decline in soybeans was the smallest.

The major soybean markets have not changed since 1970 (table 2-7). The largest importers have been the EC and Japan, accounting for approximately 65 percent of the U.S. soybean export market. Taiwan, Eastern Europe, Israel, and Western Hemisphere countries have been steady importers, but imports by other West European countries have been declining throughout the period.

Table 2-5.—Distribution of U.S. Wheat Exports by Destination, 1970.86 (in percent)

Years	Western Hemi-sphere	Europe	Middle East oil-exporting countries	USSR	Japan	South Korea	Pakistan	India	Africa	China	Other	Total
1970 -71	17.4	11.3	0.1	0	14.0	10.0	6.1	15.6	7.0	0	18.5	100
1971 -72	13.7	23.7	2.0	0	15.6	**9.0**	3.5	7.4	8.0	0	17.1	100
1972-73	19.1	12.7	4.6	0	13.4	**9.2**	5.9	5.8	11.7	**0.5**	17.1	100
1973-74	14.5	13.1	2.1	30.6	10.9	**5.2**	3.6	1.2	5.6	**7.9**	5.3	100
1974 -75	19.3	10.9	4.4	9.2	10.3	**5.5**	1.8	5.5	11.5	**9.0**	12,6	100
1975-76	14.9	10,4	7.6	3.6	12.0	**5.9**	3.3	14.3	10.7	**0.5**	16,8	100
1976-77	17.4	16.0	1.7	12.3	10.2	**4.5**	2.1	15.5	10.7	**0**	9.6	100
1977 -78	13.2	12.8	8.4	10.8	11.4	**7.4**	0.7	9.1	16.4	**0**	9.8	100
1978-79	19.6	15.0	6.7	10.7	11.6	**5.7**	2.0	1.0	17.4	**3.0**	7.3	100
1979-80	17.3	14.4	5.2	9.0	10.2	**5.0**	3.8	0.1	14.9	**7.7**	12.4	100
1980 -81	20.0	19.3	1.8	6.2	9.5	**5.0**	0.6	0.8	13.0	**11.2**	12.6	100
1981 -82	20.2	10.2	3.3	5.0	8.5	**4.9**	0.4	1.2	13.1	**18.4**	14.8	100
1982-83	18.1	9.1	1.6	13.2	7.4	**4,2**	0.5	2.7	13.5	**18.3**	11.4	100
1983-84	17.6	4.4	2.7	8.7	9.5	**5.4**	0.5	9.6	14.8	**10.2**	16.6	100
1984-85	17.5	5.6	2.7	18.1	8.2	4.8	0.3	2.7	16.2	**10.6**	13.3	100
1985-86	23.7	5.9	2.0	9.6	11.2	**6.4**	1.4	0.1	18.9	**4.6**	16.2	100

SOURCE: U.S. Department of Agriculture, "Grain and Feed Market News," Agricultural Marketing Service, Washington, DC, various issues

Table 2-6.—Distribution of U.S. Corn Exports by Destination, 1970.86 (in percent)

Year	Western Hemi-sphere	European Community	Other Western Europe	Eastern Europe	Middle East oil exporting countries	USSR	Japan	South Korea	China	Other	Total
1970-71	4.7	58.6	0	7.4	0	10	26.0	2.0	0	1.2	100
1971-72	2.9	42.3	3.4	6.9	0.1	11.8	13.8	2.7	0	16.1	100
1972-73	6.5	33.8	7.0	6.3	0.1	12.9	18.0	1.4	4.0	10.0	100
1973-74	9.9	31.8	7.5	5.4	0.1	13.2	20.0	1.2	4.2	6.7	100
1974-75	10.1	40.7	10.3	10.9	0.5	4.1	17.5	1.4	0	4.7	100
1975-76	5.8	30.0	7.6	11.1	0.2	24.8	13.6	1.4	0	5.5	100
1976-77	5.0	43.3	5.9	11.5	0.5	10.0	16,5	2.2	0	5.1	100
1977-78	6.9	27.3	8.1	10.1	0.6	20.5	17.2	3.6	0	5.7	100
1978-79	7.9	24.7	6.3	11.0	0.6	16.1	16.8	5.9	5.4	5.3	100
1979-80	13.3	21.3	8.8	12.0	0.4	9.5	18.3	3.5	2.9	10.0	100
1980-81	16.9	18.0	9.6	11.8	0.2	8.0	22.2	3.9	1.2	8.2	100
1981-82	10.3	15.7	13.0	6.5	0.1	14.5	21.5	5.1	2.6	10.7	100
1982-83	13.6	20.1	0.2	2.9	0.3	7.0	28.5	8.9	4.6	13.9	100
1983-84	11.0	17.5	0.1	1.3	0.9	13.8	30.1	6.2	0	19.1	100
1984-85	6.3	13.1	0.1	1.6	1.2	32.7	23.1	2.8	0	19.2	100
1985-86	11.2	10.1	0	3.1	1.8	21.4	29.9	4.4	0	18.1	100

SOURCE' US. Department of Agriculture, "Grain and Feed Market News," Agricultural Marketing Service, Washington, DC, various issues

GRAIN FLOW

The major tasks of the United States grain industry are to assemble grain from farmers, combine it in their facilities according to quality differentiations, store it until it is sold, and transport it by the most cost-effective means to the final market destination.

Farmers transport grain from the farm in farm-tractor wagons or trucks to country elevators, subterminal or terminal elevators, export elevators, or domestic processors (figure 2-4). From some locations, farmers can deliver grain directly to Canada from the farm by truck,

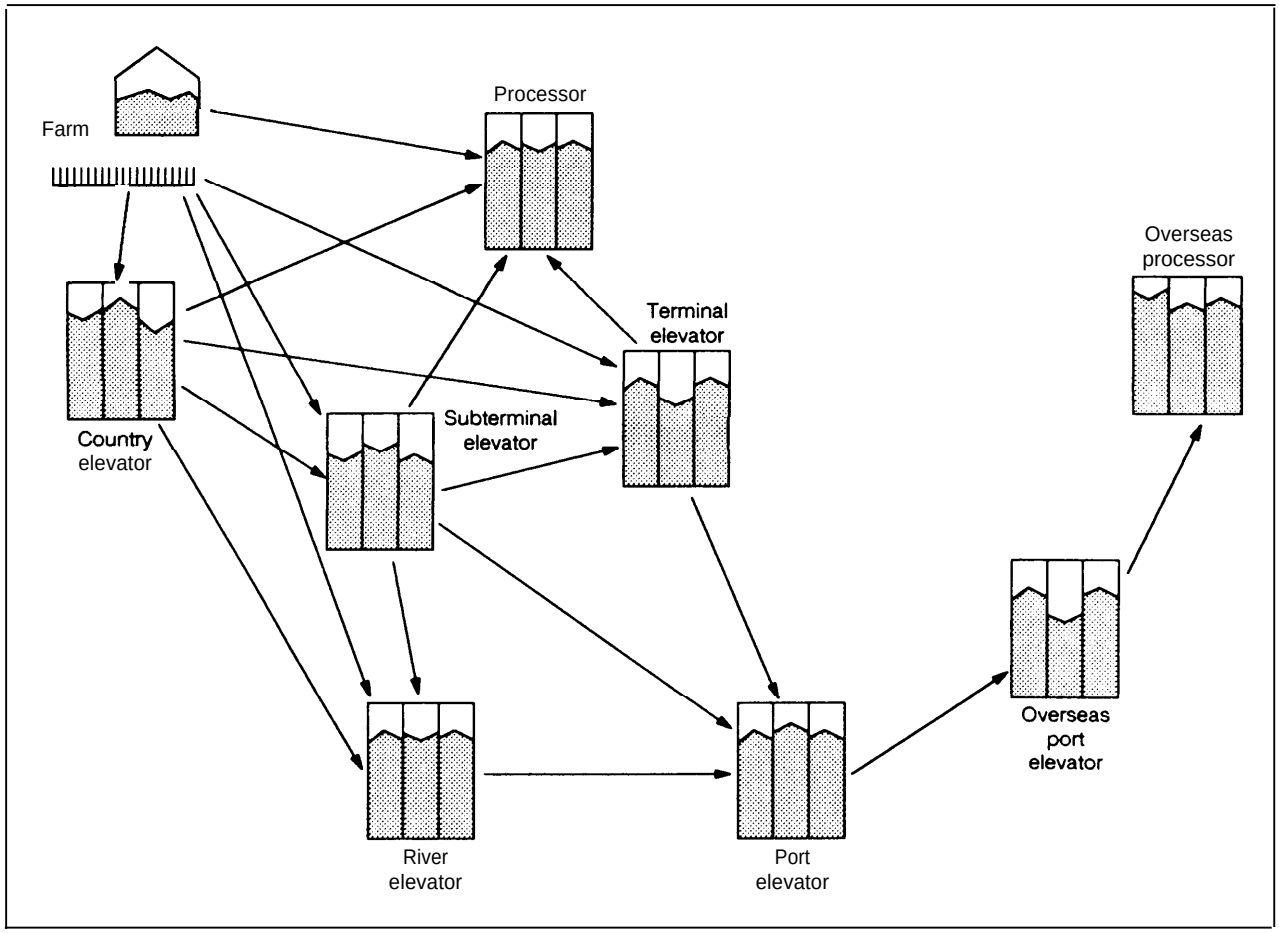
Domestic processors and export elevators can receive grain straight from farmers who are located within the general vicinity. When sufficient quantities cannot be supplied by local

Table 2.7.–Distribution of U.S. Soybean Exports by Destination, 1970.86 (in percent)

Years	Western Hemisphere	European Community	Other Western Europe	Eastern Europe	Japan	Israel	Taiwan	Other	Total
1970-71	10.3	43.4	11.8	1.4	24.2	2.8	4.7	1.4	100
1971-72	8.0	42.1	11.9	0.6	23.8	2.9	5.4	5.3	100
1972-73	5.8	44.8	8.6	1.3	25.3	2.5	4.1	7.6	100
1973-74	10.1	46.9	10.4	0.9	20,9	2.6	3.8	4.4	100
1974-75	7.5	44.1	13.2	1.2	22.7	3.5	6.6	1.2	100
1975-76	5.5	47.8	7.9	0.3	21.5	2.5	5.2	9.3	100
1976-77	7.8	46.1	6.1	0.4	20.2	2.6	4.8	12.0	100
1977-78	7.3	47.1	3.9	4.0	20.1	2.1	4.9	10.6	100
1978-79	5.8	42.2	6.6	0.4	19.2	1.9	5.8	18.1	100
1979-80	5.5	46.0	10.3	5.7	17.0	1.8	3.1	10.6	100
1980-81	9.3	43.6	9.1	4.1	19.7	1.8	5.2	7,2	100
1981-82	6.2	46.8	14.1	1.7	16.2	1.7	4,6	8.7	100
1982-83	8.2	56.0	1.2	2.4	20.5	1.8	4.9	5.0	100
1983-84	9.0	46.5	1.1	3.3	22.8	2.8	6.5	8.0	100
1984-85	10.5	44.1	0.9	2.3	24.8	2.5	7.8	7.1	100
1985-86	6.7	44.1	0.6	2.5	21.8	1.9	7.5	14.9	100

SOURCE: US Department of Agriculture, "Grain and Feed Market News," Agricultural Marketing Service, Washington, DC, **various issues**

Figure 2-4. –Grain Flow From Farm to Final Destination



SOURCE: US Department of Agriculture, "The Physical Distribution System for Gram," Office of Transportation, Agriculture Information Bulletin No 457, Washington, DC, October 1983

farmers, domestic processors and export elevators obtain grain from other sources. This is accomplished by a system of country, subterminal, and terminal elevators used to collect, store, and move grain through the system to its ultimate destination.

In many cases, grain destined for export is delivered by the farmer to the country elevator, unloaded and stored, loaded, and delivered to a subterminal elevator. Here again the grain is unloaded and stored. At subterminal elevators, it can be loaded and shipped to export elevators or terminal elevators. If subterminal elevators do not deliver the grain to its final destination, then it is delivered to a terminal elevator, unloaded, stored, and reloaded for shipment to a port. Once grain is received at an export elevator, it is unloaded and loaded onto the vessel for shipment to the importing country within a very short period of time. At export elevators the emphasis is on throughput capacity with minimal storage. At interior elevators the reverse is true, with the emphasis being on increased storage capacity and reduced handling capacity.

Grain moves by truck, railroad, barge, or ship or any combination of these modes as it makes its way from the farm to its final destination. The reported quantities of grain moved by railroads and barges is shown in table 2-8. The share by rail ranged from a high of 80.3 percent in 1974 to a low of 66 percent in 1982. Barge shares tend to rise and fall as exports increase or decrease, primarily because almost all grain moving by barge is destined for export ports in the New Orleans area. The rail share of grain moving to export ports declined from 62 percent in 1974 to 38 percent in 1983 (l). Except for the relatively small amount of grain moving into Canada by truck and into Mexico by rail, ocean vessels carry almost all exported grain.

Table 2.8.–Quantity of Grain Hauled by Rail and Barges, 1974.85

	Quantity moved (billion bushels)		Share moved (percent)	
Year	Rail	Barges	Rail	Barges
1974	4.21	**1.03**	80.3	19.7
1975	4.06	**1.20**	77.3	22.7
1976	4.10	**1.61**	71.8	28.2
1977	3.91	**1.52**	72.0	28.0
1978	4.12	**1.63**	71.7	28.3
1979	4.41	**1.62**	73.1	26.9
1980	5.00	**1.91**	72.4	27.6
1981	4.38	**1.99**	68.8	31.2
1982	4.22	**2.18**	66.0	34.0
1983	4.72	**2.11**	69.1	30.9
1984	4.81	**1.97**	70.9	29.1
1985	3.99	**1.67**	70.5	29.5

SOURCE Association of American Railroads, The Grain Book 1986 (Washington, DC: 1987)

STORAGE AND HANDLING

Grain handling and storage systems have developed over the years to provide an economical means of moving grain into storage, preserving its quality while in storage, and unloading it from storage. The total U.S. grain storage capacity in 1987 was 23 billion bushels (5), of which 14 billion bushels was on-farm storage and 9 billion was considered off farm,

Regardless of whether storage and handling systems are constructed on farm or off, basic types of equipment are being used. The only differences are in the choice of the number and types of equipment, size, capacity, and configuration.

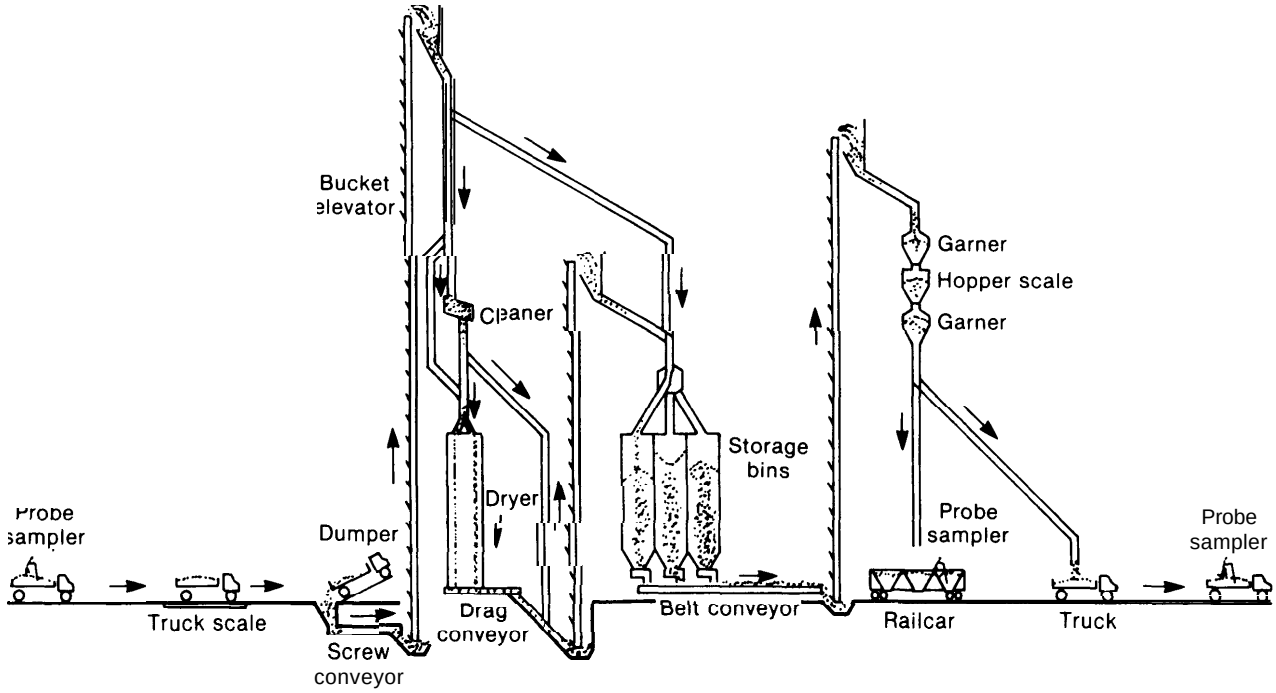
The basic storage types can be categorized as upright metal bins or concrete silos, flat warehouses (buildings), and on-ground (piles), Upright bins and concrete silos are the most easily managed type and can be found on farms as well as in commercial facilities. They range in size from farm bins as small as 3,000 bushels to over 500,000 bushels in commercial facilities. These storage types are loaded from the top and

easily unloaded from the bottom. In most instances, they can be equipped with aeration to maintain cool grain temperatures, easily sealed for fumigation when required, and, depending on the number of bins available, unloaded and turned if needed,

The recent demand for additional storage space has increased the use of flat warehouses, of on-ground piles placed on hard surfaces confined by movable sloping walls or circular rings, and of several other forms of on-ground piling. These storage types are more difficult to load, unload, fumigate, and aerate than upright bins. In the fall of 1986, approximately 300 million bushels of grain were stored in piles, By the summer of 1987 this volume had doubled, to over 600 million. Most was corn and, to a lesser extent, wheat (5).

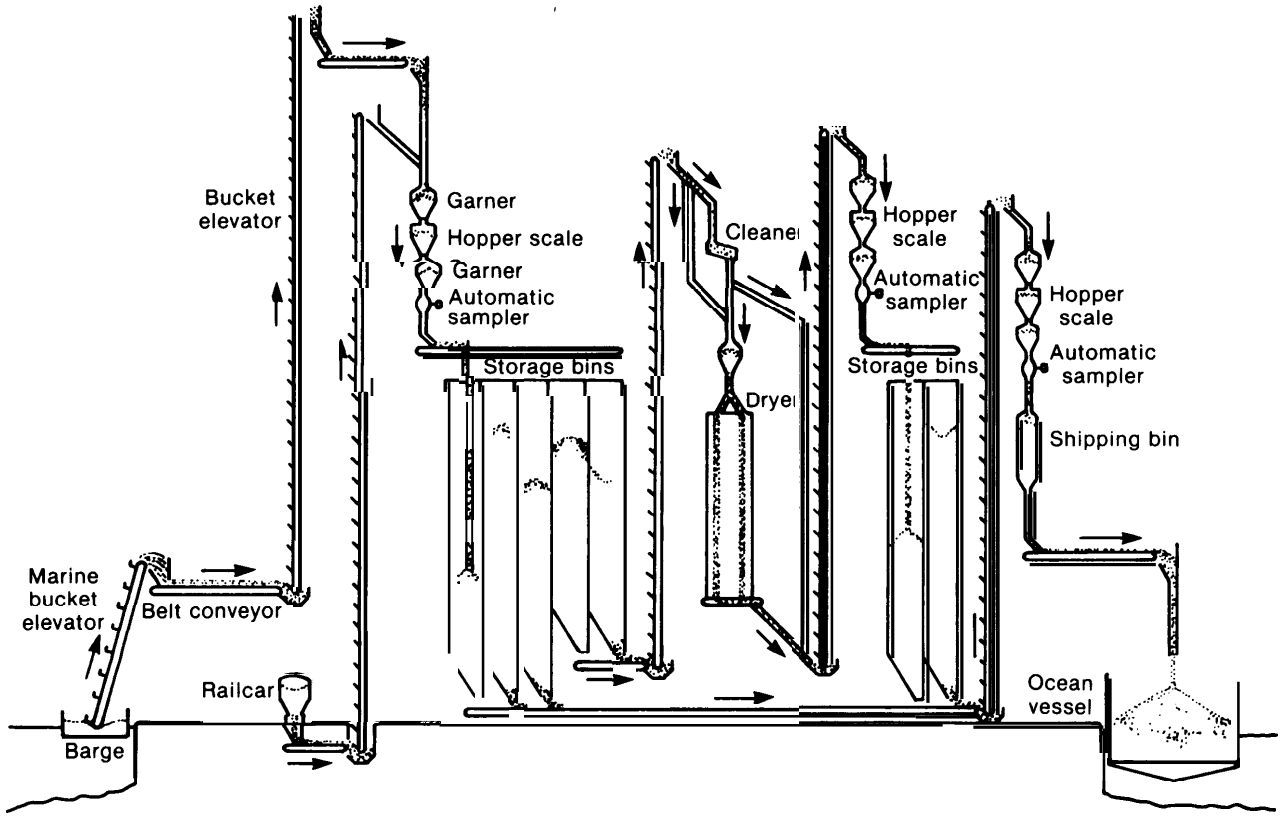
Considerable interactions occur between handling and storage technologies based on the size and type of storage structures in use. Certain kinds of handling equipment are well suited to high-speed, high-volume upright elevators; others, to flat storage or to on-farm storage. Various types of handling equipment are used to move grain horizontally or vertically within farm or commercial facilities. Figures 2-5 and 2-6 show basic flow diagrams of terminal and export elevators. Country elevators could have less equipment than shown in figure 2-5, and export elevators may have cleaners on the outbound side. Therefore, these figures only provide basic configurations and should not be taken as being representative of all grain elevators,

Figure 2-5.— Flow of Grain Through the Country Elevator



SOURCE. U.S. Department of Agriculture, "The Physical Distribution System for Grain, Office of Transportation, Agriculture Information Bulletin No 457, Washington DC, October 1983

Figure 2-6.—Flow of Grain Through the Export Elevator



SOURCE: U S Department of Agriculture, "The Physical Distribution System for Grain, " Office of Transportation, Agriculture Information Bulletin No. 457, Washington, DC, October 1983.

MARKETING OF GRAIN

A fundamental principle of the U.S. grain marketing system is that of self-selection. Producers, handlers, and users all act in their own best interests. Producers select varieties and make other agronomic decisions with the objective of maximizing profit. Handlers assemble, condition, and deliver grain subject to negotiated contract terms with the objective of maximizing profit. And users select among different qualities available, each with a different end-use characteristic, also with the objective of maximizing profit.

The market for quality characteristics is central to these decisions. Through this market, price differentials develop that provide incentives and disincentives for participants throughout the system. An important aspect of this process is that premiums and discounts, and therefore incentives and disincentives, develop for quality characteristics. Bargaining and contracting for quality specifications occurs throughout the system, explicitly and implicitly, between buyers and sellers. The premiums and discounts built into contracts reflect value to the participants.

From an operational perspective, farmers typically sell and deliver grain to local country elevators for a cash price. Farmers' decisions on whereto sell their grain are sometimes based simply on selling to the closest elevator or the one they have always sold to before. Since the middle 1960s, however, farmers have increas-

ingly searched for bids at competing elevators located as far as 40 or more miles away. They subtract the cost of delivery from the bid price at each elevator and then deliver to the one from which they receive the highest net bid,

After buying from farmers, the country elevator manager, like many farmers, also decides when and where to sell the grain to processors or exporters based almost entirely on the highest available net bid. Typically, elevators will switch shipments from one destination to another for a fraction of a cent per bushel. In this highly competitive setting, participants are almost certain to adopt innovations in technology, services, and transportation quickly. Gains that accrue to an innovator through cost-reducing procedures soon become apparent to competing firms through changing prices and a shift of grain away from their firm. This, in turn, forces neighboring firms to adopt the innovation or accept a declining volume of business,

Country elevators typically hedge their grain purchases from farmers by selling a futures contract for a similar quantity on the Chicago Board of Trade. When country elevators sell their grain directly or through a broker to grain processors, exporters, or cash merchandisers, the country elevator "lifts" the hedge by buying back a futures contract for a similar quantity from the Chicago Board of Trade, The hedge protects the elevator from the large price risks associated with changes in international grain supplies and demands. In exchange, the elevator receives the smaller price risk from the "basis' '-that is, the difference between the appropriate Board of Trade futures contract price and the local price of grain. Almost all participants in the grain trade—except speculators at the Chicago Board—hedge their purchases and sales in a similar manner.

The sales contract between the country elevator and the processor, exporter, or cash merchandiser typically specifies the terms of the sale. Unless otherwise specified in the contract, title and risk of loss or damage on domestic sales pass to the buyer as follows:

- on f.o.b. (free on board) contracts, at the moment of acceptance of the appropriate shipping document by the courier, and
- on delivered contracts, when the shipment is constructively placed or otherwise made available at the buyer's original destination (2).

Thus, the buyer is responsible for loss or damage during transit on f.o.b. sales and the seller is responsible for loss and damage during transit on delivered contracts.

Export sales are typically made directly between exporting firms and importing country buyers. In centrally planned countries, the buyer is a government agency; in most other countries, the buyer is typically a merchandiser or buying agency who buys grain and resells it to end users in the importing country.

Most U.S. export sales are made under terms specified in North American Export Grain Association, Inc. (NAEGA) contract forms. Industry sources indicate that at least half of U.S. grain export sales are made under terms specified in the NAEGA f.o.b. contract, This contract specifies that:

the quality and condition to be final at port of loading in accordance with official inspection certificates,

2. seller shall retain title to the commodity until seller has been paid in full, it being understood that risk of loss shall pass to buyer at discharge end of loading spout (3).

Therefore, the seller retains title of the grain until paid, but the buyer assumes all risk once the grain leaves the discharge end of the loading spout at the export elevator.

G0VERNMENT FARM POLICY

The main purpose of government farm policy is to support farm incomes. Several different policies and program mechanisms have been used over time to achieve this. The two main programs are the loan rate and deficiency payment/target price.

Loan Program

The Commodity Credit Corporation (CCC) makes nonrecourse loans to farmers at established loan rates for a variety of crops, including corn, wheat, and soybeans. The loan, plus interest and storage, can be repaid within 9 to 12 months and the commodity sold on the cash market. If it is not profitable for the farmer to repay the loan, CCC has no recourse but to accept the commodity in full payment of the loan. Commodity loans are frequently referred to as a price support, since national season-average prices generally do not fall below set loan levels.

The major objective of the loan program is to add price stability to the market by releasing CCC stocks when prices are high and withdrawing them when prices are low. A second objective is to encourage orderly marketing of commodities throughout the year by preventing a glut at harvest.

Deficiency Payment/Target Price Program

In the United States, deficiency payments are paid to farmers to make up the difference between a price determined to be a politically acceptable income level (target price) and the higher of the average market price or the loan rate. Deficiency payments are made on each farm's actual planted acres and farm program yield. The farm program yield is based on each farm's yield history. Deficiency payments were initiated to raise and stabilize farmer incomes, while allowing farm prices to be competitive in the export market.

QUALITY CONTROL

The United States Grain Standards Act (USGSA), administered by the Federal Grain Inspection Service (FGIS), is the statutory authority for developing grain standards. The Declaration of Policy contained in Section 2 of the USGSA states that it is Congress' intent that uniform standards for promoting and protecting grain moving in interstate and foreign commerce be developed so that grain can be marketed in an orderly and timely manner and that trading in grain may be facilitated.

Standards for wheat, corn, barley, oats, rye, sorghum, flaxseed, soybeans, triticale, sunflower seed, and mixed grain have been promulgated under the USGSA by FGIS. Each standard consists of numerical grades, i.e., 1, 2, 3, and Sample Grade. Factors are included in each standard and maximum limits for each factor have been set for each grade. The grade for any given parcel of grain is based on the factor results determined during the course of an inspection.

Section 6 of the USGSA states:

> Whenever standards relating to kind, class, quality, or condition are effective . . . no person shall in any sale, offer for sale, or consignment for sale, which involves the shipment of such grain in interstate of foreign commerce . . . describe such grain as being of any grade . . . other than by an official grade designation.

In other words, the grain standards must be used to describe grain being marketed and subsequently used as the basis for all inspections.

Grain is usually inspected each time it is handled, i.e., into and out of grain elevators. As demonstrated in figure 2-4, this could result in many inspections if grain moves through each step in the marketing chain. Two separate

USDA agencies provide and/or license individuals to perform inspection services. Private companies not affiliated with either of these Government agencies also provide inspection services.

Several authorities regulate inspection requirements by specifying who will perform these services and where. In other instances, sales contracts and individual market policies dictate inspection requirements. In all cases, settlement is based on inspection requirements as required by individual sales contracts or agreements.

No single national policy exists on inspection requirements on domestic grain. Inspection can be performed by FGIS or an FGIS-licensed inspector, by a private individual licensed by USDA's Agricultural Stabilization and Conservation Service (ASCS) under the United States Warehouse Act, by private companies, or by grain elevator employees. Three main forces determine when inspection is required: warehouse licensing requirements under the Warehouse Act or individual State warehouse authorities, the Grain Trade Rules published by the National Grain and Feed Association, and the Uniform Grain Storage Agreement administered by ASCS.

Inspection of export grain is mandatory and must be provided by FGIS or an FGIS-licensed inspector. Even though inspection by FGIS is mandatory, private companies are retained in some cases by the importing country to inspect grain and represent their interests during loading.

QUALITY AS AN ISSUE

Today more competitors exist in the international grain market than just 10 years ago. In the 1970s one-third of the world supplied grain to two-thirds of the world's people. Growth in farm trade was dynamic. Today, two-thirds of the world supplies grain to the other third. Trade growth is relatively stagnant. In such a competitive atmosphere, foreign buyers have become increasingly sensitive about the quality of grain they receive.

During the debate of the Food Security Act of 1985, several Members of Congress expressed growing concern over the quality of U.S. grain exports. Accusations were made that grain elevator operators and export traders were adultering loads of grain shipped to foreign buyers; these allegations were supported by a sharp increase in foreign complaints over quality. On the other hand, traders and handlers indicated that they have been shipping grain according to specifications, and that most of the buyers' complaints were motivated by their desire to obtain a higher grade of grain at a lower price. Much of the focus of the debate concerned the adequacy of present grain standards, which were developed over 70 years ago. Critics argue that the grain standards themselves are partly to blame for customer complaints. They claim that the grain standards have not kept pace with the changing world marketplace and are frequently misunderstood by foreign buyers.

Improving U.S. grain quality—or even the perception of quality—will be much more complicated than tinkering with the criteria for determining grain grades. Grain is vulnerable to quality deterioration at virtually every stage of the production and marketing process. Many aspects of the interrelatedness of producing, harvesting, storing, handling, and testing grain need to be understood before any changes in the system can be contemplated. Understanding these relationships is the main goal of this report,

First, it is important to clarify what is meant by grain quality. Webster defines quality as an essential character; a degree of excellence; or a distinguishing attribute. In grain, such a definition has come to mean a variety of things. Quality grain could be grain free of material other than grain, or grain not cracked or

spoiled, or grain with the proper characteristics for its ultimate use. Therefore no one definition of quality applies as it relates to grain.

For the purpose of this assessment, grain quality will be defined in terms of sanitary, physical, and intrinsic characteristics.

- *Sanitary quality* characteristics refer to the cleanliness of the grain. They include the presence of material other than grain, dust, broken kernels, rodent excreta, insects, residues, fungal infection, and other nonmillable materials. They are essentially characteristics that detract from the overall value and appearance of the grain.
- *Physical quality* characteristics are associated with the outward visible appearance of the kernal or measurement of the kernel. These characteristics could include kernel size, shape, and color; kernel moisture; kernel damage; and kernel density,
- *Intrinsic quality* characteristics are critical to the specific use of the grain and can only be determined by analytical tests. In wheat, for example, such characteristics refer to protein, ash, and gluten content. For corn they could include starch, protein, and oil content, and for soybeans, protein and oil content. These characteristics, along with the specific values, will differ, depending on the grain and its final use.

Using these grain quality definitions, the following chapters will consider various aspects of the quality issue. Chapters 3 through 5 look at which quality attributes are considered important by buyers of U.S. grain and how views on what is important change. Chapters 6 through 10 analyze the U.S. grain system's ability to produce and deliver quality grain, and compares the system with that of other major grain exporters. Chapter 11 identifies policy options to enhance the quality of U.S. grain.

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