The George Washington University

IBI – The Institute of Brazilian Issues

The Theory and Operation of a Modern National Economy

The fertilizer industry, the concentration in the pesticides/grain agribusiness sector and strategies of the firms in the United States

Spring 2001

By Romilda Resende Moreira

Contents

Page

1) The fertilizer industry 02

1.1) Structure 04

1.1.1) The basic production 05

1.1.2) The retailers 07

2) The grain sector 09

2.1) Production 09

2.2) Merchandising and processing 16

3) Changes and trends 21

4) Organization and coordination in the agribusiness sector and strategies of the firms 26

4.1) Introduction 26

4.2) The food chain clusters 29

4.3) Concentration 33

4.4) Concerns 38

4.5) Antitrust cases 41

1) The fertilizer industry

Use of commercial fertilizers in the United States was underway by the early 1840's with the introduction of peruvian guano, followed in the 1850's by superphosphate and mixed fertilizers. The U.S. fertilizer industry has enjoyed almost uninterrupted growth since its beginning.

When the fertilizers appeared, they created problems that were not easily or immediately solved. It was not until the early 1870's that the stage had been set for major advances in fertilizer production and use in the decades ahead. Commercial production of superphosphate and mixed fertilizers in the United States began shortly after the opening of Lawes' first fertilizer plant in England in 1842. The superphosphate was first produced and sold in 1852 and 1853. The new fertilizer industry expanded rapidly. Bureau of Census data show that in 1859 there were 47 superphosphate and dry-mixing plants, with an estimated production of 32.000 tons. By 1869 there were 126 plants, producing 153.000 tons of fertilizer. The discovery, in 1867, and development of domestic phosphate rock and sulfur-bearing deposits marked a major turning point for the U.S. fertilizer industry and assured the use of low-cost phosphate fertilizers.

Fertilizer companies continued to increase in size and numbers. They typically manufactured both superphosphate and mixed fertilizers or produced only mixed fertilizers. Those manufacturing superphosphate and mixed fertilizers and the larger mixers marketed largely through dealers, while the smaller mixers sold direct to farmers. Most of the larger companies required outside financial backing, and either the dealers or the companies usually provided or arranged for credit until the crops were harvested and sold. Most of the early companies were independents, owning only the plant they operated.

A trend toward consolidation began in the mid-1890's. Large parent companies acquired independent manufacturers, either as subsidiaries or affiliates, and also moved into phosphate rock mining. They not only produced their own superphosphate from their own rock, but also acquired or built their own sulfuric acid plants. Their main product, mixed fertilizers, was marketed through dealerships, which the parent company sometimes owned or controlled. They also marketed superphosphate and phosphate rock in excess of their needs.

The number of fertilizer material began to proliferate. Inorganic nitrogen forms, sodium nitrate and ammonium sulfate came into general use. Many natural organic nitrogen sources were searched out. Natural potash salts became major fertilizer materials.

Fertilizer trade associations originated as "fertilizer exchanges" in the 1860's. These were local organizations designed to unite various representatives of the trade in subjects of common concern, including price stabilization. The exchanges were located mainly in the port cities where shipments of guano and sodium nitrate entered the U.S. market. In 1876 some of the leading manufacturers formed the first national association, named *The National Fertilizer Association of Chemical Fertilizer Manufacturers*.

In 1910 the U.S. began the search for domestic sources of potash, in order to become independent of the german potash monopoly. The discovery and initial development of the domestic potash bed happened in the 1930's.

After 1920, a whole new generation of nitrogen, phosphorus, and potassium fertilizer materials emerged, replacing almost all of those that had been available. Most affected were the low-grade nitrogen materials, which were largely replaced by those based upon synthetic ammonia. The old standby phosphate material, normal superphosphate, which had provided practically all of the phosphate in fertilizers since the 1850's, gave way to more concentrated materials made possible with the introduction of phosphoric acid as an intermediate. The conglomerate of low-analysis potash materials and grades existent in the 1920's rapidly gave way to higher grade potassium materials, primarily potassium chloride.

The importance of the secondary nutrients to plant growth was generally recognized by the late 1850's. The period from about 1925 to 1950 was a pioneer era in the United States for identification and correction of micronutrient deficiencies (copper, manganese, zinc, iron, boron).

After 1955 the structure of the fertilizer industry experienced remarkable changes with the development of new techniques in basic nutrient production, granulated mixed fertilizer production, and bulk blending and liquid mixing.

Before 1955, the producers of primary nutrients provided the various fertilizer (N, P, and K) materials in pulverized or semi-granulated form and sold them to the wholesale-mixers. These plants chemically combined the basic nutrients into a few mixtures, and bagged the mixtures in small quantities. They sold and shipped these dry bags to many independent retailers for sale to the ultimate consumers, either directly off the rail car or from storage.

After the mid-1950's, the technological developments of granulation, bulk blending and liquid mixing largely replaced the old type wholesale-mixers and the small local retailers who had dealt entirely with bagged products. Bulk blending eliminated the costs of bags and bagging and reduced labor costs in handling and application.

After these technological changes, the outlets began to buy fertilizer materials from basic manufacturers of ammonia, phosphoric acid, diammonium phosphate urea, triple superphosphate, and potash; and then mix, blend, suspend or granulate, add micronutrients and pesticides, and sell it to farmers. Some of the bulk blenders are small producers of mixed fertilizers, but most are fertilizer retailers and sell directly to farmers.

The total number of retail fertilizer plants has increased from 12.131 in 1980 to 13.079 in 1990. Cooperatives at all levels-materials procurement, primary nutrient production, distribution, and retail have grown rapidly since the 1950's and gained a substantial market share. The total quantity of fertilizer plant nutrients supplied in the U.S. from 1950 to 1990 increased 6-fold, from 4.2 million tons in 1950 to 26.1 million tons in 1990, an average increase of 4.7% per year. During the same period, the total tonnage of nitrogen fertilizer nutrients supply increased by 14 fold, phosphorous fertilizer nutrients by 3-fold, and potash

fertilizer nutrients by 5-fold. The sale of dry bulk or bagged blends, and fluid fertilizers has slightly increased from 1974 to 1990, and the sale of fertilizer in the form of granulated materials and dry direct materials (such as ammonium nitrate, diammonium phosphate, etc.) have considerably decreased[1].

Since 1974, complementary services have become a vital part of the present retail fertilizer industry. This is one of the most important reasons for the growth of bulk blending and liquid mixing throughout the U.S. Since then, a considerable change in services has taken place.

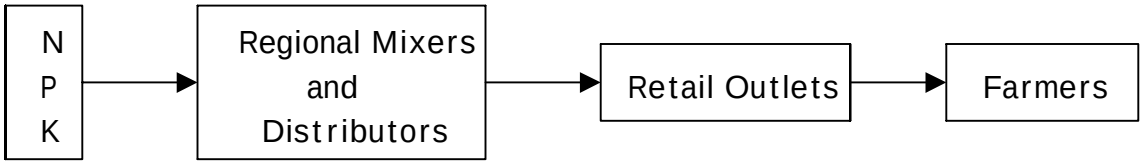
For example, in 1974, only 29 percent of the retail fertilizer firms had provided the service of adding micronutrients to fertilizers, and in 1992, almost 82 % firms add micronutrients. Almost the same trend holds for other services. Soil testing has made possible custom blending to meet farmers' requirements; custom application has reduced farm labor needs; and adding pesticides, micronutrients and other materials to fertilizer has decreased duplicated application of these important inputs. According to Akhtar, it can be concluded from the results that the retailers compete aggressively in complementary services compared to price competition. Since the price elasticities of demand and supply of fertilizer nutrients are inelastic, fertilizer retailers have to provide attractive complementary services to increase or maintain sales of their products.

1.1) Structure

The U.S. fertilizer industry is characterized by highly technological and complex operations. Its growth has been accompanied by big changes in the system of production and distribution of fertilizers.

The figure 1 shows the structure of the industry before 1955's. In this system, the basic producer obtained a reasonable price for his materials and added charges for handling, storage, and his own shipping costs. In the same way, the wholesale-mixer charged the cost of processing, paper bags, bagging, storage, and shipping to the retailer, and a reasonable return for his own investment. The retailer also added costs for unloading, storage, selling costs and profits, and charged farmers for these added items. This marketing system was a costly way to provide fertilizer to farmers.

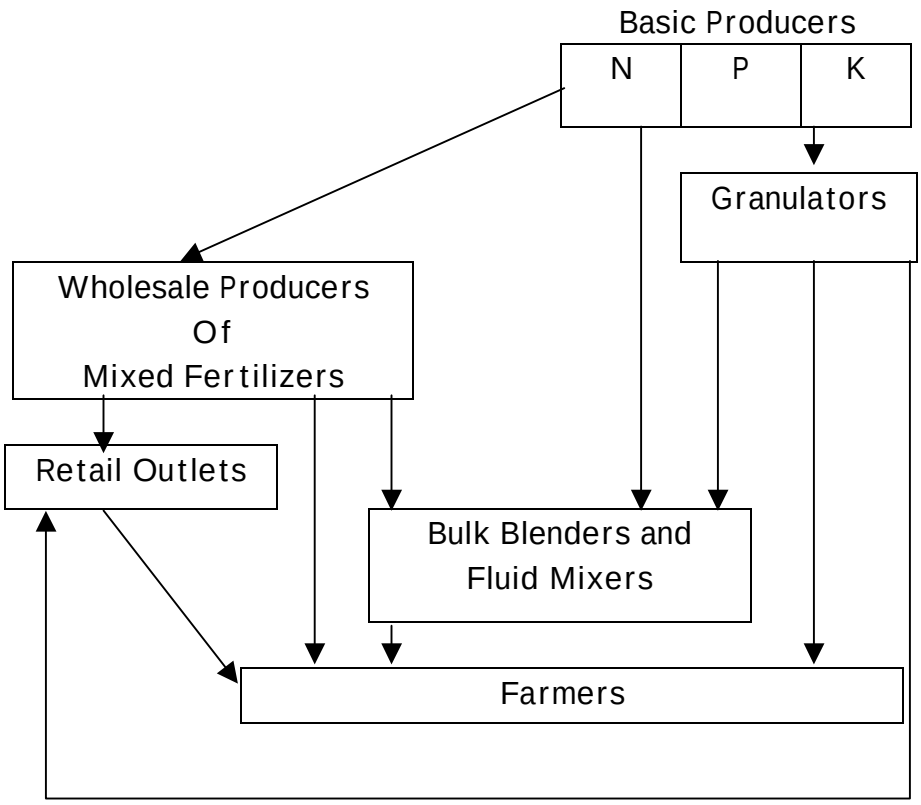
Figure 1. Structure of the fertilizer industry before 1955



[1] Akthar, Muhammad Ramzam. *An analysis of the U.S. Retail Fertilizer Industry.* 1993.

The figure 2 characterizes the present structure of the U.S. fertilizer industry. The present system eliminated intermediate manufacturers, eliminating costs of wholesale markups, wholesale freight, mixing, bagging, sales and storage. Presently, producers sell basic materials to large-scale ammoniation-granulation plants. Dry bulk blenders, liquid, and suspension-mix plants blend fertilizer mixtures for direct sales to farmers.

Figure 2. The Structure of the present U.S. fertilizer industry



1.1.1) The basic production

- Nitrogen

Nitrogen fertilizers are derived from ammonia. Efficient ammonia production requires large, capital-intensive plants. Economies of scale are significant.

The level of concentration among ammonia plants is high. In 1984, the top 4 firms produced 35% of U.S. totals, with the top eight firms producing 50% of the total. More than half of the U.S. ammonia is produced in the Delta and Southern Plains States. These areas provide readily available natural gas as well as access to rail and pipeline transportation (Akhtar, 1993).

Ammonia firms are characterized by a high degree of vertical integration. Firms are heavily involved in derivation products such as urea, ammonium nitrate, nitrogen solutions or ammonium phosphates.

In 1977, 61% of all ammonia firms owned one or more derivative plants. These plants, in turn, produced 88% of the total derivative capacity. In addition, there is a fair degree of backward linkages. Many firms were also involved in crude petroleum and crude gas extraction (Akhtar, 1993).

- Phosphate

The phosphatic fertilizer industry includes the producers and processors of phosphate rock, phosphoric acid, and sulfuric acid.

There are three major domestic phosphate rock producing areas: Florida and North Carolina, the Western States, and Tennessee. Of these three, Florida and North Carolina produce over 80% of the U.S. total. The phosphate sector has become increasingly concentrated. Prior to 1900 there were over 100 rock mining firms in the U.S. By 1984, 21 firms operated 29 mines. The top 4 firms controlling 50% of total production and 67% controlled by the top eight. Vertical concentration among the product subsectors is extensive. Producers of phosphate rock are involved extensively in the production of phosphoric acid, concentrated superphosphate, and ammonium phosphate (Akhtar, 1993).

- Potash

The U.S. potash sector is much smaller than the nitrogen or phosphate sectors. Domestic sources are found primarily in New Mexico with some additional sources in Utah and California. Since potash can be applied directly on farmer's fields with a minimal amount of processing, the potash sector lacks the intermediate derivatives as with the nitrogen or phosphate sector.

Concentration within the potash sector has historically been high. In 1960, prior to the discovery of the Canadian reserves, eight firms operated all of the U.S. mining and processing facilities.

By 1976, 15 potash firms operated within the United States and Canada. Of those, the top 4 controlled about 56% of the production capacity of the two countries. In 1993, Saskatchewan, a canadian province, with 45% of the world's known reserves, supplied the bulk of U.S. potash consumption. By 1981, Canadian mines supplied 90 % of all U.S. consumption. However, this picture must have changed over the past years.

There is a limited amount of economically accessible deposits in the U.S., thus constraining new entry to the industry (Akhtar, 1993).

There are also significant linkages among the separate fertilizer sectors. For example, in 1976, thirteen ammonia producers controlling 26% of total U.S. ammonia capacity also controlled 59% of the domestic phosphate rock capacity. Conversely, only two ammonia firms produced potash. Phosphate rock producers were also interlinked with the nitrogen and potash sectors. In addition to ammonia, several rock producers manufactured ammonia derivatives. For example, eight rock producers controlled 23% of the total urea capacity. Linkages between phosphate and potash sectors were not as strong.

1.1.2) The retailers

The 12.000 to 14.000 retail firms in the U.S. are located mostly in the North Central region, and are engaged in diverse production activities utilizing different material inputs. There is significant variability in firm size, and, consequently, in forms of business ownership.

Fertilizer retailing firms provide the link between producers and farmers. The retail firms have sought to differentiate an otherwise homogeneous product by placing an increasing emphasis on their services.

The range and type of services offered by a firm affect fertilizer pricing. An increased proportion of firms which did not bulk blend, mix or granulate (i.e. retailers only), offered a greater array of services, but even more so for bulk blend, liquid mix and granulating firms. Between 1974 and 1984, the average number of services offered by retailers only firms doubled. The same occurred among bulk blenders and fluid mixers, until those firms offered an average of more than five services per plant. The types of services offered are according to the type of production activity undertaken by a firm. The table 1 summarizes the types of services offered in 1994 and the proportion of firms doing so.

Table 1 – Services offered by the firms

Services	Retailers Only (in percent)	Bulk Blenders Only (in percent)	Fluid mixers Only (in percent)
Add seeds	29	59	30
Add micronutrients	28	79	85
Add pesticides	*	*	*
Add herbicides	34	59	81
Add insecticides	24	35	52
Bagging equipment	3	18	0,6
Spreader rental	66	88	62
Custom application	53	80	85
Soil testing	74	89	86
Consultation on service	70	73	67
Number of firms reporting	703	3,040	966

Data from 1994, reported by Swanson, Jeffrey A.

* Not included on survey.

There are different forms of business ownership in the retail firms. Table 2 classifies retail firms by type of ownership in 1980 and 1984. Between 1980 and 1984, ownership of retail only firms by sole proprietors slipped from 30% to 22%, with cooperatives picking up the gain. Sole proprietors on the other hand, apparently gained in the ownership of fluid mixing plants. This might have stemmed from the low initial investment required to start a new plant. Cooperatives, as they have sought to establish backward linkages, likewise seem to control a greater proportion of the granulation plants. Nonetheless, corporations were the overall dominant mode of ownership. Over half of all manufacturing plants were organized under corporate ownership in 1984.

Table 2 – Forms of business ownership

	Sole Proprietor		Partnership		Corporation		Cooperative	
	1980	1984	1980	1984	1980	1984	1980	1984
Retail only	29.6	22.2	8.2	8.0	45.6	48.0	16.6	22.7
Blenders, mixers and granulators	9.0	10.5	5.0	4.8	51.6	51.4	34.4	34.1
Bulk blenders	7.0	7.6	3.7	4.3	46.1	47.2	43.2	41.6
Liquid mixers	13.0	16.0	7.3	5.6	63.1	61.8	16.6	17.6
Suspension mixers	12.0	16.3	6.7	4.6	71.6	68.7	9.7	11.0
Granulators	1.3	4.2	-	2.8	81.0	67.6	17.7	26.8

Data reported by Swanson, Jeffrey A.

- Bulk Blending firms

Bulk blending comprises the major share of chemically mixed fertilizers. In bulk blending, a few basic high analysis materials containing single nutrients (or, in case of ammonium phosphate, both N and P) are shipped in bulk form to retail bulk blending plants. These firms physically combine these nutrients in mixers according to the needs of individual farmers. Dry bag blenders mostly sell their product through dealers, whereas, dry bulk blenders work both as producers and dealers, and frequently provide local services which are no generally provided by the dry bagged blenders. The rapid increase in importance of bulk blending was due to its being a good business both for the blender and the farmer. In contrast with the old dry-mix producer, the new blender retained both the mixers and dealers' profits. The farmer, in turn, could get the fertilizer applied on his land for about the same price, as he would have paid for bagged mixers before spreading[2].

Fertilizer materials used for bulk blending are ammonium nitrate, ammonium sulphate, triple superphosphate, potassium chloride, urea and diammonium phosphate.

The first firm to produce and spread custom-made bulk blends commercially, apparently, was the Schofield Soil Service, at Paxton, Illinois, in 1944 (Lewis, 1990). In the early 1960's, the importance of bulk blending of fertilizer was realized, and soon spread throughout the Corn Belt (east and west Central States).

The bulk blending industry developed without organized research input or promotion by state, or by federal agencies, and hence became direct sellers to farmers. One survey held by the Tennessee Valley Authority (TVA) with the Association of American Plant Food Control Officials, shows that dry blends rose from 33% of the total U.S. fertilizer distribution in 1974 to 41% in 1992. On the other hand, bagged blends dropped from 9% to 5% during the same period.

[2] Nelson, Lewis B. *History of the U.S. fertilizer industry.*1990.

- Fluid Mixed Fertilizers Firms

The industry of fluid fertilizer mix (liquid and/or suspension fertilizer) also grew rapidly throughout the United States after the 1960's. The basic fertilizer nutrients in fluids exist either in dissolved form in clear solutions, or at stable suspensions of solid particles. Fluid fertilizers have many advantages over the others, such as, ease of mixing, incorporating additives and securing homogeneity of the mixture, convenience of mechanical handling, and high reliability in application in the fields. Suspension fertilizers are liquids in which salts are suspended by the incorporation of a suspending agent, and complete solubility of phosphate is not required in suspension, which permits a wider range of phosphate materials to be used.

The liquid-mix fertilizer plants also distribute bulk dry mixtures and materials such as ammonium nitrate and diammonium phosphate. These fluid fertilizer plants also provide other complementary services, such as addition of pesticides and micronutrients, soil testing services, consultations, custom application, etc.

- Granulate Fertilizer firms

Granulation plants have undergone changes due to the change in their material usage. Many of them installed pipe-cross reactors, that permit the use of large quantities of phosphoric and sulfuric acid, anhydrous ammonia, and other fluids to produce dry granular NPK fertilizers. Meanwhile, the use of more conventional materials such as triple superphosphate, normal superphosphate and MAP decreased.

The granulation plants produced 20-25% of the total fertilizer distributed in the United States in 1974, but by 1980 their market share had fallen to 16%.

Granular NPK plants required a relatively large capital investment to be built. In 1962, 250 granular plants of various sizes were in operation. However, the number fell to 118 in 1973 and to 107 in 1980, the survivors being mostly the larger regional plants. Granulation plants have economies of scale. In 1984, their average size was over 68,000 tons. As firms diversified activities, this apparently gave much greater opportunity for increased processing capacity, with averages increasing to almost 104,000 tons. per plant[3].

2) The grain sector

2.1) Production

Grains, members of the grass family, are generally divided into bread grains and feed grains. The bread grains include wheat and rye, and the feed grains include corn, oats, barley, and grain sorghums. The soybean is actually a legume; but since its growing, handling, and trading are so much like those of the grains, it is considered as a grain.

[3] Swanson, Jeffrey A. *The U.S. Fertilizer Industry.*

The corn and soybean belt is concentrated in a relatively narrow band across the center of Indiana, Illinois, and Iowa. These deep fertile soils with generally adequate rainfall levels represent the largest contiguous region in the world ideally adapted to corn and soybean production (Hill, 1990). Although there are periods of weather adversity, the soil structure and topography provide resilience to adversity, and serious crop failures are rare.

States to the west and south of this corn and soybean belt have less reliable rainfall patterns and their crops often require supplemental water through irrigation. The soils and climatic conditions of the west and southwest regions are better suited to the production of grains sorghum and wheat.

The states to the north and east of the Corn Belt are still productive corn producing areas. Minnesota, Michigan, Ohio, and Wisconsin are all important in the production of corn. However, the shorter growing season reduces their importance in terms of soybean production. Oats and wheat are relatively more important in the cropping patterns of these Lake states than in the states of Iowa and Illinois. Barley is grown primarily in the northern plain states.

Although some of the soils in the southeastern United States are less fertile than those of the Midwest, the region is still highly productive, with generally adequate rainfall. The soils and climate are well adapted for soybean production, with some land effectively devoted to corn. The low-lying lands of the Mississippi Delta are highly fertile, with high rainfall. These states bordering the lower Mississippi River are adaptable to production of a wide range of crops but the primary grains are rice and soybeans. California also has an area of soil and climate well adapted to certain varieties of rice production.

The tables bellow provide data in crops value of production for the years 92 to 97 and in crops supply, demand and price from 1999/00 to 2001/02.

Table 3 - Crops Summary: Value of Production, United States, 1992-94

Crop	Value of Production		
	1992	1993	1994
	1,000 Dollars		
Field & Misc Crops			
Corn for Grain	19,723,258	16,035,515	22,874,154
Sorghum for Grain	1,667,194	1,234,500	1,317,149
Oats	399,595	290,948	299,627
Barley	946,463	812,889	783,709
All Wheat	8,009,711	7,647,527	7,968,237
Winter	5,226,189	5,287,607	5,578,351
Durum	306,498	324,049	449,041
Other Spring	2,477,024	2,035,871	1,940,845
Rice	1,057,272	1,246,875	1,336,570
Rye	27,303	27,149	30,520
Soybeans for Beans	12,167,564	11,941,449	13,746,071
Flaxseed	13,543	14,857	13,590
Peanuts	1,285,361	1,030,904	1,229,012
Sunflower	250,748	326,432	512,747
Canola	14,262	27,476	49,802
Rapeseed	1,449	761	1,292
Safflower	57,159	81,580	62,488
Mustard Seed	1,545	1,336	1,401
All Cotton	4,273,935	4,520,908	6,796,654
Upland	4,081,657	4,366,534	6,630,582
Amer-Pima	192,278	154,374	166,072
Cottonseed	608,438	714,389	771,315
All Hay, Baled	10,435,994	10,946,576	11,113,274
Alfalfa	6,388,048	6,779,565	6,817,717
All Other	4,047,946	4,167,011	4,295,557
Dry Edible Beans	457,269	538,210	631,080
Dry Edible Peas	21,801	23,796	25,256
Wrinkled Seed Peas	7,250	11,746	9,474
Austrian Winter Peas	1,010	1,457	612
Lentils	28,814	30,090	25,613
Potatoes	2,336,478	2,642,699	2,593,446
Sweetpotatoes	146,499	166,506	187,206
Tobacco	3,059,246	2,829,161	2,779,056
Sugarbeets	1,206,480	1,023,687	1,234,470
Sugarcane for Sugar and Seed	852,235	885,459	900,765
Pepermint Oil	94,723	80,139	109,255
Spearmint Oil	46,645	33,488	27,592
Coffee (HI)	4,080	6,525	12,040
Maple Syrup	39,125	23,493	32,248
Mushrooms	669,894	685,750	716,464
Hops	129,328	133,965	134,701
Taro (HI)	3,002	2,760	2,806
Ginger Root (HI)	6,380	5,247	5,220
Total Above Crops	70,051,053	66,026,249	78,334,916

Source: 1997 Economic Census Comparative Statistics for United States. Bureau of Census.

Table 4 - Crops Summary: Value of Production, United States, 1995-97

Crop	Value of Production		
	1995	1996	1997
	1,000 Dollars		
Field & Misc Crops			
Corn for Grain	24,202,234	25,149,013	22,351,507
Sorghum for Grain	1,389,772	1,986,316	1,408,909
Oats	278,941	313,910	273,284
Barley	1,028,183	1,080,940	861,620
All Wheat	9,787,766	9,782,238	8,286,741
Winter	6,720,901	6,396,217	5,948,655
Durum	567,541	541,993	422,497
Other Spring	2,499,324	2,844,028	1,915,589
Rice	1,587,236	1,690,270	1,756,136
Rye	28,948	33,118	30,120
Soybeans for Beans	14,599,145	17,439,971	17,372,628
Flaxseed	11,481	10,197	14,046
Peanuts	1,013,323	1,029,774	1,002,703
Sunflower	457,573	414,842	426,766
Canola	60,837	62,048	88,235
Rapeseed	361	429	230
Safflower	64,479	71,964	60,491
Mustard Seed	2,227	2,434	9,402
All Cotton	6,574,612	6,408,144	5,975,585
Upland	6,358,184	6,136,592	5,708,940
Amer-Pima	216,428	271,552	266,645
Cottonseed	731,005	914,564	835,371
All Hay, Baled	11,035,838	12,726,992	13,249,825
Alfalfa	6,776,873	7,800,171	8,099,822
All Other	4,258,965	4,926,821	5,150,003
Dry Edible Beans	633,620	652,240	576,658
Dry Edible Peas	45,062	29,638	42,658
Wrinkled Seed Peas	14,672	8,877	10,743
Austrian Winter Pea	1,440	1,329	1,231
Lentils	37,300	22,758	31,351
Potatoes	2,995,711	2,423,476	2,622,621
Sweetpotatoes	203,799	190,529	211,177
Tobacco	2,307,168	2,853,739	3,217,176
Sugarbeets	1,070,663	1,211,001	1,160,029
Sugarcane for Sugar and Seed	906,441	833,297	890,257
Pepermint Oil	130,048	128,778	128,846
Spearmint Oil	27,858	26,094	29,128
Coffee (HI)	16,200	20,800	28,200
Maple Syrup	28,719	42,169	35,216
Mushrooms	760,489	757,531	766,434
Hops	135,087	123,530	119,840
Taro (HI)	3,264	2,793	2,805
Ginger Root (HI)	5,046	7,050	8,107
Total Above Crops	82,176,548	88,452,793	83,886,076

Source: 1997 Economic Census Comparative Statistics for United States. Bureau of Census.

Table 5 - Wheat: Supply, Demand, and Price, 1999/00-2001/02

	1999/00 1/	2000/01 2/	2001/02
Area planted (mil. Acres)	62.7	62.5	61.0
Area harvested (mil. Acres)	53.8	53.0	52.5
Yield (bu./acre)	42.7	41.9	40.5
Production (mil. Bushels)	2,299	2,223	2,125
Beginning Stocks	946	950	839
Imports	95	95	100
Supply	3,339	3,268	3,064
Feed and residual	284	300	275
Food, seed, & industrial	1,016	1,029	1,043
Total Domestic Use	1,300	1,329	1,318
Exports	1,090	1,100	1,025
Total use	2,390	2,429	2,343
Ending stocks	950	839	721
Farm Price ($/bushel)	2.48	2.65	2.85 3/

1/ Forecast. 2/ Projected. 3/ Mid-point of forecast range.
Source: USDA.

Table 6 - Corn: Supply, Demand, and Price, 1999/00-2001/02

	1999/00 1/	2000/01 2/	2001/02
Area planted (mil. Acres)	77.4	79.6	78.0
Area harvested (mil. Acres)	70.5	72.7	71.2
Yield (bu./acre)	133.8	137.1	135.9
Production (mil. Bushels)	9,431	9,968	9,675
Beginning Stocks	1,787	1,718	1,891
Imports	15	10	10
Supply	11,232	11,696	11,576
Feed and residual	5,664	5,775	5,800
Food, seed, & industrial	1,913	1,980	2,040
Total Domestic Use	7,578	7,755	7,840
Exports	1,937	2,050	2,100
Total use	9,515	9,805	9,940
Ending stocks	1,718	1,891	1,636
Farm Price ($/bushel)	1.82	1.80	1.95 3/

1/ Forecast. 2/ Projected. 3/ Mid-point of forecast range.
Source: USDA.

Table 7 - Soybeans: Supply, Demand, and Price, 1999/00-2001/02

	1999/00 1/	2000/01 2/	2001/02
Area planted (mil. Acres)	73.7	74.5	75.5
Area harvested (mil. Acres)	72.4	72.7	74.5
Yield (bu./acre)	36.6	38.1	39.5
Production (mil. Bushels)	2,654	2,770	2,945
Beginning Stocks	348	290	345
Imports	4	3	3
Supply	3,006	3,063	3,293
Feed and residual	1,579	1,590	1,645
Food, seed, & industrial	164	168	173
Total Domestic Use	1,743	1,758	1,818
Exports	973	960	1,000
Total use	2,716	2,718	2.818
Ending stocks	290	345	475
Farm Price ($/bushel)	4.63	4.65	4.25 3/

1/ Forecast. 2/ Projected. 3/ Mid-point of forecast range.
Source: USDA.

Table 8 - Soybean Meal: Supply, Demand, and Price, 1999/00-2001/02

Thousand short tons	1999/00 1/	2000/01 2/	2001/02
Beginning Stocks	330	293	275
Production	37,623	38,132	39,235
Imports	49	50	65
Supply	38,003	38,475	39,575
Domestic Use	30,378	31,200	31,900
Exports	7,331	7,000	7,400
Total Use	37,710	38,200	39,300
Ending Stocks	293	275	275
Avg. Meal Price ($/ton)	168	178	170 3/

1/ Forecast. 2/ Projected. 3/ Mid-point of forecast range.
Source: USDA.

Table 9 - Soybean Oil: Supply, Demand, and Price, 1999/00-2001/02

Million pounds	1999/00 1/	2000/01 2/	2001/02
Beginning Stocks	1,520	1,995	2,290
Production	17,824	17,920	18,505
Imports	83	75	75
Supply	19,427	19,990	20,870
Domestic Use	16,055	16,400	16,800
Exports	1,376	1,300	1,650
Total Use	17,432	17,700	18,450
Ending Stocks	1,995	2,290	2,420
Avg. Oil Price ($/lb.)	0.156	0.135	0.135 3/

1/ Forecast. 2/ Projected. 3/ Mid-point of forecast range.
Source: USDA.

According to a 2001 report of USDA, the U.S. economy continues to enjoy its longest expansion in history (although slowing considerably in recent months), characterized by strong income growth, low unemployment, surging productivity, and low inflation and interest rates. Production agriculture, while bolstered by the expansion, has been particularly vulnerable to foreign competition, a strong dollar, economic recession in foreign countries, and increases in energy costs. Prices of many agricultural commodities are beginning to pick up. In February of 2001, the index of prices received for all crops was up 5 percent from a year earlier and the index of prices for livestock was up 9 percent. Nevertheless, the commodity price recovery is generally from relatively low levels. For the 1999/2000 marketing year, the average price of soybeans was the lowest since 1972/73, the prices of corn and wheat the lowest since 1986/87, the price of rice the lowest since 1992/93, and the price of cotton the lowest since 1974/75.

For bulk products such as feed grains, wheat, soybeans, cotton, and rice, export value declined one-third from 1996 to 2000. Accounting for nearly all of the drop in export value of bulk commodities were lower export prices, with export volume falling only slightly. In contrast, the export value of high-value agricultural products (total agricultural exports minus bulk commodities) remained nearly steady at about $32 billion during 1996-2000.

In 2001, the value of bulk exports is forecast to increase $0.5 billion to $18.3 billion, remaining well below 1996's $28 billion, while volume is expected to be just under 1996's 119.4 million tons. The export value of high-value agricultural products is forecast to increase to $34.7 billion in 2001, bringing total export value to $53 billion this year. This is up from the recent low of $49 billion 2 years ago, but still well below the 1996 record.

Farm cash receipts are forecast to reach $200 billion in 2001, up $4 billion from last year. This would be the second-highest level of farm cash receipts, surpassed only by the 1997 record (nearly $208 billion). Crop receipts in 2001 are projected to be down $11 billion from 1997, while livestock receipts are forecast to be up about $3 billion. Compared with last year, crop receipts are forecast to increase by $3.6 billion to slightly over $100 billion,

while livestock receipts are projected to be about unchanged at slightly under $100 billion. These aggregate figures mask steep declines in cash receipts and income for major crops.

Cash receipts for grains, soybeans, and cotton, projected to increase slightly to $45 billion in 2001, will be down from a record $57 billion in 1997. Assuming no supplemental assistance for 2001 crops, net cash income is projected to decline from $56.4 billion last year to under $51 billion in 2001, as production expenses continue to rise and government payments decline. Increases in petroleum prices and interest rates along with higher prices for other production inputs, including hired labor, increased farmers' production expenses by 4 percent or $7.6 billion in 2000, with higher fuel and oil prices accounting for over one-third of the increase. In contrast, farm production expenses rose only 1 percent from 1997 to 1999.

2.2) Merchandising and processing

Procurement prices for grains are established mainly in open market transactions that are based largely on futures market prices. Futures markets for grains are price discovery centers. Large numbers of buyers and sellers assemble at futures markets to evaluate supply and demand conditions and to act on the basis of their evaluations. Prices generated in futures markets are relied upon as benchmark prices. Individual transaction prices for grains are often calculated by negotiating price differentials from futures prices. The differential between the cash price and the futures price is known in the trade as the basis. Fluctuations in basis values reflect location, transportation, timing of delivery, storage costs, financing, grade and quality factors, cash demand, and other considerations that affect the value of a particular transaction.

Firms in the grain industry typically own and operate some storage facilities or arrange for storage, as a part of their overall operations. In order to hedge against price risk, or manage risk, grain firms usually participate actively in futures markets. Their skill and success in managing price risks through futures trading and merchandising generally have a major influence on their overall earnings.

In some industries the opportunities to use futures markets are greater than in others. For example, active futures markets exist for both soybean meal and soybean oil, as well as for soybeans, permitting the employment of a wide variety of merchandising strategies in their industry. Cross hedging, that is, hedging the cash position in a commodity against a futures position in another commodity, is often done to reduce price risk for commodities without futures markets.

Because grains and soybean are bulky relative to value, transportation is a major economic factor for these commodities. In the late 1830s railroads became the leading transportation mode. They were the principal movers of grain from the mid-1800s through World War II. Due to the railroad rate increases that came later, grain shippers sought other transportation modes. Improved righways and water routes have expanded the areas accessible to trucks and barges, reduced their costs, and helped make them strong competitors.

Some grain firms own and operate transportation equipment such as barges, ships, rail cars, and trucks. The availability of transportation equipment when needed can have a major effect on grain merchandising margins and profitability of grain firms. Decreasing rail services in some areas have caused industry adjustments. Thus, transportation considerations have an important influence on locations of processing facilities, and rate changes can greatly affect the profitability and competitive positions of individual firms.

Grain is procured by processing industries primarily from merchandisers who operate country, subterminal, or terminal elevators in or near major grain producing areas. Farmers typically sold to the local elevator, either private or farmer-owned, which set commodity prices based on a relationship to terminal market prices and futures quotations, the relationship usually based on transportation costs to terminal markets. An increasing proportion of processor grain needs is obtained directly from farmers. The proportion obtained directly from farmers is expected to rise further as farms grow larger.

While the country elevator operator usually derives a considerable portion of his income from buying and selling grain, income is also obtained from performing customer services such as conservation or improvement (by drying or blending) of grain quality, merchandising certain farm supplies, and providing grain storage for producers and processors.

The most common outlets for a country elevator's grain are both the terminal and subterminal markets. Terminal markets are major grain handling and export facilities such as Chicago, the Gulf of Mexico, Norfolk, Minneapolis, Portland, and St. Louis. Terminal elevator operators buy grain from many sources including subterminal elevators, river houses, country elevators, and cash grain merchants. Depending on the terminal elevator's facilities and location, grain may be received by rail, truck, barge or lake vessel.

The competition for the commodities collected by the elevator system comes from several sectors. The terminal elevator operator sells grain to processors, millers, distillers, feed manufacturers, exporters, and, on occasion, to elevator operators in other parts of the country.

Most products derived from the grain commodities move through channels of trade, along with basic ingredients from other sources, into consumer-oriented industries that manufacture a wide variety of food and nonfood products. Important among these are industries that produce and market bakery and cereal products, pet food and edible and non-edible oils. The proportions of farm produced grains that are taken by domestic grain processors vary greatly among the grains.

For wheat, the supply is divided among several hundred-flour millers and several exporters, the percentage to each sector determined by supply and demand. About 40% of corn production that is marketed (the remainder is used for feed on the farm) is divided among

exporters and wet and dry corn processors. Marketed beans are divided between exporters and domestic crushers, who produce meal, flour, oil and grits[4].

The processing industries of flour milling, rice milling, corn wet milling, corn dry milling, manufactured feed, barley malting and soybean processing had a value of shipments around $ 31 billion in 1982, approximately 11% of the value of shipments of the food and kindred products industries[5]. Table 10 shows the relative sizes of those industries in terms of value of shipments and estimated proportions of the values made up of grain ingredient costs. The industries are grouped according to whether they turn out products that are used primarily by other processing industries or for the consumer market. While some firms in both groups produce products for both outlets, the groupings generally show that at the first stage of processing, relatively larger fractions of the value of shipments are accounted for by grain and grain product costs. Firms that produce products primarily for the consumer market incur other non grain product costs that are relatively much greater than the costs of the grain input.

Table 10 - Value of shipments in 1982 of major U.S. food manufacturing industries that utilize grain (including soybean) and grain products, with estimated percent of value accounted for by grain ingredient cost.

Census Industry	Value of shipments ($ million)	Estimated grain ingredient costs (% of value of shipments)
Industries that produce products primarily for other industries		
2041 Flour and other grain mill products	4,933	60
2044 Rice milling	1,934	62
2046 Wet corn milling	3,268	42
2048 Prepared feeds	11,298	39
2974 Cottonseed oil mills	933	53
2075 Soybean oil mills	8,604	69
2076 Vegetable oil mills	557	29
2083 Malt	662	61
Industries that produce primarily for consumers		
2043 Cereal	4,132	5
2044 Blended and prepared flour	1,419	20
2047 Dog, cat, and other pet food	4,402	11
2051 Bread, cake, and related products	13,143	10
2052 Cookies and crackers	4,665	7
2079 Shortening and cooking oils	4,906	40

Source: Farris et al.,1988.

[4] Lauck, Jon. 2000. *American Agriculture and the Problem of Monopoly – The political economy of grain belt farming, 1953-1980*.
[5] Bureau of the Census.

The table 11, bellow, present the share of shipment value in food processing industries and its evolution from 1967 to 1992.

Table 11 - Share of shipment value in food processing industries - 1967 to 1992

Industry	1992	1987	1982	1967
Flour and grain milling	56	44	40	30
Breakfast cereals	85	87	86	88
Rice milling	50	56	47	46
Prepared flour mixes and doughs	39	43	58	68
Wet corn milling	73	74	74	68
Pet food	58	61	52	-
Prepared feeds	23	20	20	-
Breads and cakes	34	34	34	26
Cookies and crackers	56	58	59	59
Cottonseed oil mills	62	43	51	42
Soybeans oil mills	71	71	61	55
Other vegetable oil mills	89	74	52	56
Malt beverages	90	87	77	40
Macaroni and spaghetti	78	73	42	31

Source: Statement of Mr.Keith Collins, Chief Economist of the U.S. Department of Agriculture, before the Committee on Agriculture, Nutrition, and Forestry. United States Senate. January 26, 1999.

The table 12 provides data in value of shipments of crop manufacturing industries in the years 1992 and 1997, and the percentage of increase.

Table 12- Crop manufacturing industry - Value of shipments

Industry	Value of shipments ($ 1,000) 1992	Value of shipments ($ 1,000) 1997	% of change
Soybean oil mills	10,650,587	13,352,991	44,2
Rice milling	1,650,680	2,374,891	43,9
Flour and other grain mill products	6,294,383	8,044,903	27,8
Wet corn milling	7,045,211	8,455,172	20,0
Cotton seed oil mills	730,079	844,960	15,7

Source: 1997 Economic Census. Bureau of Census.

Grain processing, along with most manufacturing industries, has undergone profound changes as industries have increased in size and complexity during recent decades. Firms have grown much larger, and many became highly diversified. In general, the largest firms

are the most diversified. Many small grain processing firms have gone out of business or have been acquired by other firms.

In the beginning of the century XIX, mergers created the Corn Products Refining Company, which processed 65% of wet corn until it was divested by the government. When world war II ended, the company's share dropped to 45%, and by the 1980s a dozen firms processed wet corn, including ADM, Cargill, Corn Products (which changed its name to CPC International), and several farm cooperatives. The size of the industry expanded dramatically in the 1970s with the development of high-frutose corn syrup (HFCS), a perfect substitute for beet sugar, and the development of ethanol promotion policies following the oil shocks(Lauck, Jon.2000).

In 1946, 89 different firms processed 16,000 tons of soybeans; by 1984, 34 firms processed 127,000 tons of soybean. Many of the firms that failed did so because of their older, less efficient, hydraulic presses, which were displaced by new screw presses. Soy oil was also subjected to competition form substitute oils and fats, but remained a strong industry due to its many uses, accounting for 2/3 of fats and oils used for margarine and shortening and 3/4 of fats and oils used for cooking and salad oils. Processing by the top four firms was 44% in 1946 and grew to 65% in 1984, but included different firms. World demand also shaped the industry: prior to the 1970's the U.S. exported 90% of the world's soybean; by the 1980 this dominance was undermined by the large soybean production increases in Brazil and Argentina[6].

Changes in the market structure of wheat milling led to a decrease in the number of flour mills. The total number decreased from 1.243 in 1947 to 361 by 1982[7]. In 1962, the Farmers Cooperative Commission Company started processing bulgar wheat, and GTA processed durum wheat. In the 1980s ADM, ConAgra, and Cargill bypassed large firms such as General Mills and Pillsbury, which were not even top firms in the 1960s.

Technology played an important role in market structure changes. For example, in the 1880s the state of Minneapolis developed as the wheat-milling center of the country, due to the growth of higher-quality wheat from the northern and the development of a new milling process. In the 1950s Pillsbury developed a process for altering the protein content of wheat, which allowed for the production of different types of flour from the same variety of wheat. Other wheat-milling centers such as Kansas City and Buffalo also developed, putting more pressure on the large Minneapolis-based firms. Falling postwar demand also contributed to the demise of many milling operations[8] . Millers in wheat growing regions also suffered when it became cheaper to transport wheat than to transport flour (owing to changes in rail rates), causing a boom in milling near urban areas of consumption.

---

[6] Lauck, Jon. 2000. *American Agriculture and the Problem of Monopoly – The political economy of grain belt farming, 1953-1980*.

[7] Lauck, Jon. *American Agriculture and the Problem of Monopoly – The political economy of grain belt farming, 1953-1980*.

[8] In 1947 european countries required 100 million tons of flour, but by 1954 the requirement fell to 17 million tons.

Food processors also competed for grain with the expanding feed manufacturing industry, which grew from fourteen hundred firms in 1939 to twenty-four hundred by 1959. While a total of 7 million tons of corn were used in both dry and wet milling, 13 million tons were used for feed manufacturing. By 1975, over six thousand feed manufacturing plants existed; entry into the industry remained easy and product differentiation low. In 1982, the top-four firms manufactured only about 20% of feed. Farmers could also mix and grind their own feed on the farms (Lauck, Jon. 2000).

While competition has kept the grain-processing sector dynamic in the postwar years, substantial concern does exist about the trend toward conglomeration. Cargill, for example, owns plants in wheat, bean, and corn processing, in addition to elevators, exporting facilities, a meatpacking division, and operations in many other sectors. CR4, a measure of concentration using four firm concentration ratios is quite high in grain and oilseed milling industries, and the measures have generally grown through time.

The same large agribusiness firms are the leaders in each industry, and are active in other related businesses (such as grain merchandising or livestock feeding). Increasingly, farmers deal with a common small set of very large agribusiness corporations in a variety of different contexts.

These aren't the only agribusiness sectors showing increased concentration. Recent mergers have reduced the number of independent railroads, important in grain and fertilizer shipments, to two or sometimes three in most parts of the country. Census Bureau data show increased concentration in some traditional input industries like agricultural chemicals. Finally, recent and likely future mergers among supermarket chains, which may not greatly alter the number of stores that consumers generally have available to shop at, may still sharply reduce the number of different chains competing to buy produce from agricultural shippers. In short, farmers do face significant reductions in the number of competing buyers across a wide range of markets.

3) Changes and trends

U.S. agriculture is in the midst of major structural change—changes in product characteristics, in worldwide production and consumption, in technology, in size of operation, and in geographic location. Production is changing from an industry dominated by family-based, small-scale, relatively independent firms to one of larger firms that are more tightly aligned across the production and distribution chains. The sector is becoming more industrialized, more specialized, more integrated, more managerially intense, and the pace of change is increasing.

The agricultural revolution brought about major changes in farming. Before 1940, the farmer and his family provided most of the farm labor. Machinery and mechanical power were limited largely to 2-plow tractors, 1-row corn pickers, and 2-row planters. Capital requirements were minimal and the per acre return from his crops was limited. The amount of purchased feed, seed, and livestock was low, and cropland acreage farm remained stable and relatively low. Use of fertilizers was low and lime was sparingly applied.

From 1940 to 1960, the volume of purchased off-farm inputs roughly doubled and continued to increase thereafter. The farm labor input declined drastically, falling nearly 80% for 1940 through 1980. The total input from land remained about the same over the entire 1920-1980 period, not surprising since the United States has only about 340 million acres of harvested cropland without bringing less desirable land under cultivation. Fertilizers increased a huge 1,240 per cent, followed by farm machinery with a 200 percent increase, and feed, seed, and livestock by 180 percent. Fertilizers proved to be one of the most effective substitutes for land since it usually increase crop production appreciably at a relatively low cost.

Farming became big business in areas with a favorable climate, good soils, and a level topography that would accommodate large machinery. Leading examples include the Corn Belt, the wheat and sorghum producing areas of the Great Plains, and certain irrigated areas in the western states. Large family-operated commercial farms in 1979 utilized capital resources of about US$ 500,000, with some running to US$ 2 to US$ 3 million. Low agricultural prices lead to consolidation as firms seek to survive in low-margin businesses by becoming larger to increase efficiency and lower cost structures.

There is an increasing consolidation via horizontal mergers of firms and a movement forward solidifying relationships between firms who operate at different value-adding steps along the supply chain, i.e., production, processing, and distribution.

Previous analyses and studies sponsored by National Grain and Feed Foundation, particularly during the 1980s, demonstrate that a dramatic shrinkage in grain export markets and declining grain industry asset prices forced additional consolidation than what otherwise might have occurred. For example, an Iowa State University study found that the average annual return on investment for elevator companies for 1985 to 1990 was only 5.7%, which is considerably below average industry-wide returns on capital at risk. A private study found that companies specializing in export operations were ill equipped to manage the downturn and were compelled to exit the industry. Other studies by USDA confirmed low rates of return for farmer cooperatives handling and marketing grain[9].

Assessing the impact of this concentration on producers is difficult for a number of reasons. First, focusing on concentration in one segment of the industry may mask the alternative marketing opportunities facing the farmer in other segments. For example, some producers may be able to market their grain to a variety of outlets including elevators, feed lots, or industrial users such as ethanol plants, while others may face very limited opportunities beyond the local elevator. Second, since many companies are privately owned, data on grain merchandising are not generally available, so it is difficult to assess the degree of concentration in many segments of the industry.

In areas not adjacent to water transportation and distant from consumption points, rail transportation tends to dominate as the low-cost mode. Overall, rail represents more than 40

[9] Kendell Keith, President of the NGFA, in his statement in the *2000 Competitive Issues in Agriculture and the Food Marketing Industry*. Hearing before the Committee on the Judiciary. House of Representatives. October 20, 1999.

percent of commercial grain movements. Consolidation in the rail industry has encouraged grain companies, even smaller companies, to own or operate multiple plant locations in order to preserve access to multiple destination markets. If a grain elevator operation has rail loading facilities on two separate rail lines within the same marketing region, there is an additional degree of protection in the event one railroad may have service interruptions (car shortage, logistical stoppages, force majeure, etc.) or uneconomic rates to certain destinations. In such situations, it is more likely that the elevator industry will seek to consolidate.

The average size of shipments in rail units has also encouraged consolidation. As the rail industry became less regulated, the trend toward lower rates for larger shipment sizes accelerated. The result is that there are, nowadays, more unit train loading stations at local grain origination points serving farmers. These locations have the capacity to load 15-car, 25-car, 50-car, and 100-car units, depending on the type of destination markets being served. The lower rates of larger units have benefited big farms by reducing average transport cost to destination markets. At the same time, elevator companies have been required to manage multiple facilities, some truck-to-rail "feeder" stations, to be able to justify the extensive multi-million dollar investment required to build such high-volume, rapid-loading plants[10].

Complex consumer preferences and rapidly developing biotechnology also drive vertical or supply chain consolidation where firms who perform different functions along the marketing chain seek tighter alliances with each other. Such alliances may be motivated by the desire for access to a particular market, the need to preserve intellectual property rights, or the need to control the environment in which inputs are produced.

Segregation of grains are required by specialty markets and biotechnology. Grains and oilseeds produced in the U.S. and globally have for the most part been marketed and handled as fungible commodities that can be commingled by grain type, i.e., corn, wheat (by class), soybeans, sorghum, barley, oats, rye, etc. However, in the last 10-12 years, there has been a steady growth in markets for "specialty grains" such as high-oil corn, waxy corn, and other grains that require segregation within the bulk handling system. After 1995/96, there has been substantial growth in biotechnology-enhanced grains. While many of these biotechnology-enhanced products have been approved by U.S. regulators as "substantially equivalent" to traditional varieties, some customers are now requesting segregation. The trend toward greater segregation result in more incentives to consolidate to manage the intricacies of serving a wider range of specific end-use customer needs. The need for product traceability has increased as consumers demand higher food safety and food quality standards. This traceability may be accomplished through third party certification of the environment or may require direct monitoring or ownership of the production facility. Either method implies strengthening the relationship along the supply chain to get the final product to market.

This movement toward increasingly differentiated products is bringing more contracts into field crop production.

[10] Kendell Keith, President of the NGFA, in his statement in the *2000 Competitive Issues in Agriculture and the Food Marketing Industry*. Hearing before the Committee on the Judiciary. House of Representatives. October 20, 1999.

Recent technologies may favor the increase of vertical integration in the crop sector. With the acquisition of the Precision Farming's Global Positioning System technology, it is no longer necessary for the farmer to have personal contact with their land and crop to make appropriate management decisions. Most of the decisions can be made in the farmer's office. Any decisions that can be made without contact with the land and the crop can be made in an office in a distant city.

The agricultural biotechnology has favored vertical integration in the US agribusiness sector. Biotechnology refers to the process whereby the genetic structure of a plant can be altered by physically inserting genes with desired characteristics. Developments in biotechnology are likely to have many far reaching impacts on agricultural production and on food processing and consumption. According to Raper, in the case of biotechnology there has been a rapid alignment of major players at various stages of the marketing chain, as firms scramble to be connected to a "life sciences complex" for producing and marketing genetically modified organisms - GMO's. An example of a negative effect brought by the biotechnology is that with the biotechnology and the terminator gene the farmer may be at the mercy of the food cluster for seed to plant the crop. If the firms in the processing stage of the cluster require specific genetic material and the farmer cannot get that seed, his access to the market is restricted.

As biotechnology has spread through the seed industry, a striking reorganization of firms and industry structure has taken place. Large diversified firms, with backgrounds in agricultural chemicals (DuPont, Dow, Monsanto) or in pharmaceuticals (Novartis, Aventis) made large investments in the industry through a series of acquisitions of seed companies and small biotechnology research firms (trait developers). Seeds have become a concentrated market (some crops more than others), with a small set of large firms active across many crop categories.

Major agricultural chemical firms have begun to align themselves with seed companies in efforts to assure their place in the supply chain for the biotechnology revolution. The DuPont's purchase of Pionner/Hi-Bred International, Inc. is an example. Pionner was the last remaining independent seed company of significant size and the leading supplier of agricultural genetics. Other example is Monsanto's purchase of Dekalb Genetics Corp. and of Cargill's international seed operations. This follows a trend of mergers and exits in the agricultural chemistry industry as developments in crop genetics and biotechnology have put downward pressure on margins for the industry.

Mergers in the chemical industry enabled Novartis to jump to top position in the pesticide market. The purchase of seed companies by the third and fifth largest pesticide firms, Monsanto and DuPont, have placed them in the first position in the world seed industry. Novartis is second in pesticides and third in seeds. Since the early stages of the plant biotechnology industry, Monsanto has dominated U.S. and world markets.

In 1997, Monsanto announced it would sell off its bulk chemical business to concentrate on high technology life sciences. Monsanto acquired three important biotechnology firms, purchasing 100% of Agracetus and Calgene, and most of technology assets of Ecogen. Monsanto also purchased the corn and soybean seed business of Asgrow, the largest soybean producer; Holdens Foundation Seeds, which is the largest foundation seed firm in the U.S.; Dekalb, the second largest cotton seed producer in the U.S. and Cargill's international seed business.

In the U.S., almost 90% of the acreage planted with genetically engineered seed are using Monsanto Products (Brennan, Pray and Courtmanche,1999).

DuPont has purchased the Feed Company Protein Technology and formed a joint venture with Pionner, called Quality Grain (Raper,1999).

Another interesting trend is the increased merger activity between large chemical and pharmaceutical firms. In 1994, the german firms Hoechst and Shering formed a joint venture for their agricultural and environmental products called AgrEvo. The swiss firms Ciba-Geigy and Sandoz merged in 1997 to become Novartis. In 1998, Hoechst and Rhone-Paulec announced their intention to merge and form a new company called Aventis.

In the study named *Impact of Industry Concentration on Innovation in the U.S. Plant Biotech Industry*, in 1999, the analysis of field trial data for private firms shows that the concentration in this industry is growing. Since 1995 there has been a decrease in the output by smaller firms, and a negative impact in efficiency, while output by the top four industries has increased. That appears to be supporting the theory that industry concentration is causing reduction in research and development activity in smaller firms. Many of the firms have their agricultural divisions up for sale. There are likely to be many sales, divestitures, and reorganizations of biotechnology firms in the near future.

Biotechnology research is complex and increasingly expensive. There may be economies of scale in some parts of the research effort--that is, large firms may be more effective at developing and marketing new seeds. But, according to the study mentioned, research effort is only part of the story. The outcome of the research process is a new trait. Traits must still be combined with existing seed types that contain other desired characteristics. Research firms and existing seed companies reach agreements on transferring knowledge and research traits among themselves, but those arrangements often don't work smoothly, and as a result seed firms often ally or merge with research firms. Moreover, the newly developed seeds often create complementarities with agricultural chemicals. Those modified seeds may reduce the need for herbicides or pesticides, or they may alter the mix of specific agrichemicals that a farmer needs. Because a farmer's chemical and seed decisions are often now made jointly, and because agrichemical companies possess strong research organizations and extensive marketing organizations, there are also mergers and alliances among chemical firms, research firms, and seed firms. Nevertheless, the authors conclude that there is still competition. Major firms are able to compete, and they continue to increase their investments in R&D, allowing them to challenge Monsanto, the industry leader. According to the authors, biotechnology reorganizations are not driven by clear

economies of scale in production. Rather the shifting set of mergers and alliance reflects a search for the most effective ways to develop and to exploit biotech research.

4) Organization and coordination in the agribusiness sector and strategies of the firms

4.1) Introduction

Structural change in agriculture refers to changes in the number and size distribution of farms and agribusiness firms, changes in production characteristics across farms and firms and the changing that farms and firms make with one another. Structural change is studied because of concerns over its economic and social effects.

As U.S. farms have consolidated, the number has declined from nearly 7 million in the 1930's to 2.2 million in 1998, and the share of production accounted for by the larger farms increased, raising concerns over the level of economic opportunity for small farms. Similarly, as agricultural industries became more concentrated with a smaller number of firms dominating the market, concerns have been raised over the degree of competition in some markets.

While the number of predominantly, family-operated grains and oilseeds farms has declined over time and a larger share of production is accounted for by an increasingly smaller number of producers, farm production remains still unconcentrated. Because of this, producers are generally price takers.

As grain leaves the farm gate, the number of firms involved with marketing and processing grains is smaller. The buyer customer base is shrinking. The customers for feed and grain, including feeding operations, processors, and food companies are also consolidating. As these numbers have declined, such companies are seeking grain marketing supply firms that can serve an increased proportion of annual grain needs. As firms consolidate and find ways to handle and market more grain with fewer human resources, other firms are challenged to do the same to remain in business.

There are many causes of consolidation in U.S. agriculture. A dominant cause is economies of scale from technical change, which increases labor productivity and reduces production costs over larger volumes of production. Consolidation may also be encouraged by pecuniary economies related to size, such as volume-based price reductions on production inputs which can lower per unit production costs or premium prices on large volumes of specific outputs which increases per unit returns.

According to grain firms, one of the major factors causing consolidation in their business has been the trends in rail shipping. Consolidation among the railroads would have encouraged grain firms to own or manage facilities on multiple rail lines simply to protect against the loss of economic access to markets. They claim that grain firms are being compelled to expand to protect their interests and the business interests of their farmer customers. The other factor in rail that has pushed companies to grow would be the growth in average shipment sizes. Railroads offer strong incentives to ship multicar-trains rather

than single cars. Companies would have been challenged to manage more locations to attract business volume to load the trains to both compete for the grain and to acquire low-cost freight for farmers (Hearing before the committee on the Judiciary. House of Representatives,1999).

The business community allege that the growing number of government regulations related to occupational safety and health, environmental concerns, employment, transportation, warehousing, and the many other areas of the business force companies to develop additional areas of expertise to stay in business, making it difficult for small companies with fewer resources—both human and capital—to stay current and in full compliance with this myriad of business regulation.

Agricultural markets have a wide range of mechanisms for achieving vertical coordination in food production, distribution and marketing. These alternatives range form an open production system with commodities sold on spot markets to vertical integration with multiple levels of the food system being under the control of an individual firm's ownership (table 13).

Vertical coordination refers to all possible economic arrangements involved in transferring resources between economic stages. For the most part, firms in different stages of food production coordinate the transfer of inputs and outputs through open production, contract production or vertical integration.

Historically, open production has been the prominent way in which the food industry has allocated resources between stages. In open production, the producer does not commit itself to selling the output before completing production. Cash (spot) prices coordinate resource transfer across stages of production.

Contract production is production for a forward market[11]. The relationship between buyer and seller is closer than in open production. Before completing production, a producer commits to deliver a particular product to a particular buyer.

Strategic alliances are informal collaborations between firms based on trust, and involve a transfer, or sharing, of assets.

Table 13 – A Taxonomy of vertical coordination mechanisms

Spot Markets (open production)
Contracting Market specification Production management Resource providing Relational contracts
Strategic alliances
Vertical integration

[11] In a forward market, transactions relate to goods and services to be delivered sometime in the future.

Source: Schweikhardt, David and Greenwalt, Bert. Market coordination in the U.S. rice industry: firm responses to changing demands for product quality. *Vertical relationships and coordination in the food system.*

While other agricultural commodities have witnessed a greater use of contracting or vertical integration than the grain sector, grain production and marketing may be approaching the use of coordination mechanisms other than open production systems, as changes in technology create the demand for products with specific attributes needed by food manufacturers. This increased demand will likely be lead by the demands of food manufacturers seeking to serve specific target consumers with goods possessing specific qualities. The production of these goods is likely to require that grains be produced with specific attributes needed to achieve the product qualities demanded by consumers.

Potential benefits and costs accompany increased consolidation and coordination. Benefits include higher quality products available at lower consumer prices and more efficient use of production resources, enabling resources to move to production of other products thus increasing national living standards. Costs include issues related to environmental quality, economic viability of small farm and firm operations, and effects on rural communities dependent on agriculture. If consolidation results in concentration, potential costs include the exercise of market power in unduly discriminatory or predatory ways.

The development of tighter linkages in the food production and distribution industries may have a major impact on market access in both the input and product markets. The development of larger scale firms raises questions about concentration and oligopoly and monopsony, if not monopoly, power in negotiating terms of exchange.

The major concern about concentration in the food system focuses on the control exercised by a handful of firms over decision-making throughout the food system. The question is who is able to make decisions about buying and selling products in a marketplace. The focus of economic power is usually placed on the individual firm and its market share. For some of the global firms, this is still somewhat appropriate. However, decision-making can also be exercised through the various relationships in which a firm is involved even if it does not hold a majority share. The changing nature of the food system suggests that relationships among the firms are becoming much more complex and much more important (Heffernan ,William.1999).

Competitive markets require many buyers and sellers combined with an open exchange of market information. Lawmaking government bodies and regulatory agencies face a dilemma referred to by economists as the Williamson tradeoff. Growth and consolidation among firms can happen due to enhanced technical efficiency and reduced costs associated with production, processing, and distribution of products within an industry consisting of large firms. However, the resulting concentrated structure may facilitate noncompetitive behavior among the few remaining firms, leading to net social costs in terms of higher consumer prices and lower prices for producers.

According to Koontz[12], concentration is not the cause of low prices and profitability in agriculture. However, there are specific issues, which have arisen out the continued consolidation. There are serious questions about market access for independent producers, market entry for firms with innovative ideas, service of the general public interest by large businesses, and policy inconsistencies, which have contributed to increased consolidation and concentration.

4.2) The food chain clusters

In the past, most of the global grain firms were family-held operations that tried to maintain low visibility and were quite secretive about their transactions. These firms operated in one or two stages of the food system and in a very few commodities. Today the system is becoming much more complex starting with involvement in biotechnology, extending through production, and ending with highly processed food. Increasingly, these firms are developing a variety of different alliances with other players in the system. Acquisition is still a common method of combining two or more firms, but mergers, joint ventures, partnerships, contracts, and less formalized relationships, such as agreements and side agreements, are also utilized.

In a food chain cluster, the food product is passed along from stage to stage, but ownership doesn't change and neither does the location of the decision-making. Starting with the intellectual property rights that governments give to the biotechnology firms, the food product always remains the property of a firm or cluster of firms. The farmer becomes a grower, providing the labor and often some of the capital, but not owning the product as it moves through the food system and not making the major management decisions. According to Heffernan, experiences in other economic sectors, like the auto industry, suggest that monopolies seldom evolve. Oligopolies tend to emerge.

In his study *Competitive issues in agriculture and the food marketing industry* presented the Committee on the Judiciary, House of Representatives, in 1999, Heffernan predicts the development of four or five food clusters. The number of clusters will be heavily influenced by the number of firms who have access to the intellectual property rights. The underlying assumption in this study is that biotechnology will be accepted by most nations of the world. This assumption is made because the monopoly power that accompanies the intellectual property rights that leads to control of the gene pool will be most difficult for any new or emerging cluster to obtain.

The main clusters created in the agribusiness sector, as defined by Heffernan, are presented bellow:

- **Cluster Cargill/Monsanto**

  Monsanto is one of the leading biotechnology firms. The joint venture between Monsanto and Cargill announced in 1998, established one of the clusters. Cargill had

[12] Koontz ,Stephen R. Department of Agricultural and Resource Economics. Colorado State University. Statement in the hearing before the United States Senate. April 2000.

already established its own food chain over the past several years by planned acquisitions. It was one of the largest seed firms in the world with seed operations, including research operations, in twenty-three countries of the world. However, Cargill did not have access to biotechnology and the new genetic products it would produce. Thus, they sold their international seed operation to Monsanto and their domestic seed operation to AgrEvo, a Berlin-based joint venture between Hoechst and Schering. Cargill then formed a joint venture with Monsanto, the company that had the intellectual property rights to develop the genes and had a very comprehensive array of seed firms.

Most seed companies have either aligned themselves with, or been acquired by, crop-biotechnology giants such as Monsanto Co., DuPont Co. and Dow Chemical Co.

According to Heffernan, industry analysts suggest one of the reasons Cargill needs more facilities is to position the company as a major grain trader as identity-preserved products come on line. Those promoting value-added opportunities for farmers have suggested that small, single facility firms, like new generation cooperatives, might find a niche in the handling of identity-preserved products because the big grain traders could not or would not come into such small markets. With the additional facilities Cargill has just acquired, it is in position to utilize a facility in the center of a farming region that could produce the new product and contract with surrounding farmers for the product. Cargill could use marketing contracts or production contracts much like it does in the poultry sector.

- **Cluster ConAgra**

  ConAgra is one of the three largest flour millers in North America and ranks fourth in dry corn milling in the U.S. The company produces its own livestock feed and ranks third in cattle feeding and second in cattle slaughtering. It ranks third in pork processing and fifth in broiler production and processing. ConAgra's United Agri Products (UAP) business is a leading distributor of crop protection chemicals, fertilizers and seeds in the U.S., Canada, Mexico, Chile and U.K. UAP is moving into new markets around the world, such as through a joint venture with Zeneca Agrichemicals (now AstraZeneca) in the Cape region of South Africa, which establishes a base for UAP growth on the African continent. ConAgra is a leader in the distribution of new biotechnology products, principally seeds.

  In the handling and transportation of grain, ConAgra owns about 100 elevators and 1,000 barges and 2,000 railroad cars. ConAgra's grain trading company, Peavey, is ranked third in ownership of U.S. covered barge fleet. American Commercial Barge Lines, Inc., is number one, followed by Artco, a company owned by Archer Daniels Midland. According to Heffernan, in 1995, these top three controlled 53% of the nation's covered barge fleet.

ConAgra has an Agri Products division teaming with DuPont in a group of joint ventures, about a dozen developmental businesses. ConAgra's range of expertise may make it especially attractive to potential business allies like DuPont.

ConAgra and ADM formed a joint venture in mid 1998 to operate the Kalama grain export facility in Washington State. The new company, owned 50–50 by the two firms, is known as Kalama Export and operates one of the most efficient export facilities on the West Coast. The facility was built by ConAgra, which operated it from 1983 until the joint venture formed.

In another grain-based alliance, ConAgra and Farmland Industries have linked together to improve both companies' services to farmers and grain marketing and export activities. The alliance consists of two entities, Concourse Grain and Farmland-Atwood, with Concourse Grain operating two ConAgra export elevators and two Farmland elevators (one export, one interior) and marketing wheat originated by the two companies. This alliance enables domestic and wheat customers to access multiple classes of wheat, and international customers to be served from multiple U.S. export points. Prior to these grain ventures, ConAgra created a joint venture with Harvest States Cooperatives in 1994 to operate three elevators in Iowa and two export grain terminals in Louisiana. The 50–50 partnership, called HSPV, was expected to improve efficiency and flexibility in grain origination, shipment and handling of grain exports for both Harvest States and ConAgra's grain export company, Peavey .

ConAgra follows the processing of food farther down the food chain than Cargill and ADM, selling labeled food items such as Armour, Monfort, Swift, Butterball, Healthy Choice, Peter Pan Peanut Butter, Hunt's, and others. It currently ranks second behind Philip Morris as the leading food processor in the U.S. In its 1998 Annual Report, ConAgra noted 18 consecutive years of earnings per share growth at a compound rate of 15 percent. Fiscal 1998 sales totaled $23.8 billion and fiscal 1998 operating profit, $1.6 billion. Chief Executive Bruce Rohde has set a goal of making ConAgra the world's largest and most profitable food company by the year 2005. This means passing not only Philip Morris, but also world-leader Nestle of Switzerland. ConAgra's growth during the 1990s has been accomplished through a strategy of acquisitions, divestitures and adding value to their products. Under the leadership of Philip Fletcher, the company's practice was to have 80–100 acquisition candidates in screening at all times. ConAgra was able to report in 1998 that it had acquired or created joint ventures with approximately 150 companies during the past 10 years.

- **Cluster Novartis/ADM**

  Novartis is a Swiss firm formed by the merger of CIBA-Geigy and Sandoz in late 1996. According to their 1997 Annual Report, the company has agribusiness operations in 50 countries worldwide. Their business is primarily in crop protection chemicals, seeds and animal health. The merger of the two large chemical firms—plus the acquisition of Merck in 1997—puts Novartis in the leading position in the global agrochemical field with sales of $4 billion in 1997. This left Monsanto, Zeneca (a British firm that recently merged with a Swedish firm to create AstraZeneca) and DuPont all vying for second place in the global agrochemical field. In 1997, *Europe Chemical News* estimated that Novartis had 15% of the global agrochemical market. Moreover, the company has the largest R & D budget in the life sciences industry according to their own press release

in May 1997. Their emphasis on R&D is also reflected in their collaboration with the University of California-Berkeley, where they recently signed a 5-year $25 million research agreement to work in all areas of functional genomics related to agriculture, including gene-library construction, sequencing, mapping and bioinformatics.

The Novartis/ADM connection is established through Novartis joint venture with Land O' Lakes to develop specialty corn hybrids for the food and feed markets. Novartis purchased a 50% interest in Wilson Seeds Inc., a subsidiary of Land o' Lakes. The joint venture also acquires genetics from Sturdy Grow Hybrids, already in a venture with Novartis to introduce a white corn hybrid with the Bt trait. Land O' Lakes maintains an alliance with Growmark (energy products) and recently took over Countrymark, a major eastern Corn Belt cooperative, both of which are in joint ventures with ADM.

ADM, with its vast network of processing facilities, lacked access to farmers, a problem the firm remedied through a long-standing joint venture with Growmark and the more recent ones with Countrymark, Riceland, and United Grain Growers. The Growmark and Countrymark joint ventures, for instance, give ADM access to 50% of the corn and soybean market region, and 75% of Canada's corn and soybean market region. The 42% share ADM gained in United Grain Growers gives ADM widespread access to farmers in eastern Canada.

For the cooperatives who lacked the net of large firms in downstream processing—as in the case of Minnesota Corn Processors, a new generation wet corn milling cooperative that sold a 30% non-voting share to ADM—ADM offered a global network in which to sell their grain. ADM has also used joint ventures with cooperatives such as Goldkist and Ag Processing Inc. (AGP) in the feed business.

The Novartis/ADM connection is also important because Novartis—while a truly global and powerful company with substantial sales in chemical, seed, animal health and human nutrition products—lacked access to further processing in either grain commodities or food products. Novartis needs ADM's grain handling and processing web to be able to guarantee producers using their seed stock a downstream market. ADM, on the other hand, lacked access to biotech and needs Novartis' genetics, seed stocks and chemicals.

ADM's stake in A. C. Toepfer, one of the world's largest grain trading firms, allowed ADM to process 45% of the commodities entering Eastern Europe from the West in 1993. ADM has also pursued joint ventures and acquisitions in Latin America in the last few years. Their purchase of parts of Glencore's holdings in Brazil and Paraguay generated a 4% increase in their share of the world's soybean trade. Moreover, they maintain joint ventures in a variety of different commodity processing and feed operations in Brazil, Paraguay, Bolivia and Mexico. ADM has also advanced into the Chinese market through its oilseed refining, feed and broiler processing operations, where ADM is the junior partner with the Chinese government and a local processor.

According to Heffernan, there are a host of major players in the food system, which are not included in these three food chain clusters. Some have already begun to form alliances and others are still acting in a rather individualistic manner. Most likely, some of these will join

together to form new food chain clusters, while others may join the clusters already identified. Pioneer and Mycogen can form the anchor for other chains. Firms like American Home Products, DuPont, Dow, AstraZeneca, and Aventis, a recent joint venture of Rhone-Poulenc and Hoechst-Schering, are likely to join a cluster, as are some of the fertilizer firms. Bunge, a major grain trader, and some major animal production and processing firms like Tyson, Perdue, Smithfield and its alliance members Carroll's Foods and Murphy Family Farms, might well develop a working relationship. There are already relationships between many of these firms and some of them have or have had relationships with firms in the three clusters identified. The system is very dynamic. A look at the list of acquisitions and mergers during the past decade, suggests far more names were lost as firms joined another management unit than new names emerged. Many of these new names are simply the realignment of existing firms.

Heffernan believes that a very small number of dominant food chain clusters are to emerging. Some are organized around one or two dominant players as exemplified in the cases of Cargill/Monsanto and ConAgra. The Novartis/ADM case suggests another method of building a food chain cluster that is probably the path many of the major key players not yet involved in a cluster will follow.

4.3) Concentration

Reviews of the identity of buyers of agricultural products or sellers to agriculture producers shows that the same companies appear again and again. DuPont provides insecticides and herbicides as well as providing Pioneer Hybrids. Monsanto is also a leading producer of seeds and crop protections. On the other side, Cargill, ADM, or ConAgra appear many times among the leading firms in various kinds of food processing and distribution.

The CR4 - the concentration ratio (relative to 100%) of the top four firms in a specific industry, a measure that reflects the share of the market controlled by the top four firms - has increased over time in many markets. According to Raper, 1999, in the crop sector concentration is relatively high in flour milling (CR4=62), dry corn milling (CR4=74), soybean crushing (CR4=80), and ethanol production (CR4=67). Add totally, multiple elevator companies control 24% of the grain arriving at grain elevators and 59% of the port facilities for grain export. With Cargill's agreement to purchase Continental Grain's grain operations, Cargill alone will handle 10% to 13% of all U.S. grain moving to market and 35% of U.S. grain exports.

Data presented by Keith Collins, Chief Economist of the U.S. Department of Agriculture, before the Committee on Agriculture, Nutrition, and Forestry in 1999, demonstrate that the degree of concentration among grain and oilseed processing firms is largely related to the degree of processing. According to Collins, the top four cereal manufacturers accounted for about 85 percent of the sales in 1992. Flour and other grain milling were less concentrated; the top four firms accounted for about 56 percent of the market in 1992. Most industries have exhibited trends towards greater concentration over the period 1967-1992, with some exceptions (e.g., prepared flour mixes).

According to Heffernan's study presented before the Committee on the Judiciary, House of Representatives in 1999, the top four firms control 79 percent of beef processing capacity (compared to 36 percent in 1980), 57 percent of pork processing capacity, 62 percent of flour milling, 57 percent of dry corn milling, 74 percent of wet corn milling, 80 percent of soybean crushing and 67 percent of ethanol production.

In the tables 14 to 20 below, there are some data presented by the National Farmers Union before the Committee on the Judiciary, House of Representatives, in 1999. The names of the four firms in each sector are displayed, as well as the CR4 for the sector, when available. Fifth and sixth top companies are occasionally shown as supplemental information.

Table 14 - Animal feed plants
Top four firms:
1. Cargill (Nutrena)
2. Purina Mills (Koch Industries)
3. Central Soya
4. Consolidated Nutrition (ADM + AGP)
Sources cited: Feedstuffs, 10/28/91 and 2/21/94.

Table 15 - Multiple elevator companies [CR4 = 24%]*
Control by top four:
1. Cargill Capacity in Bushels = 24%
2. ADM (ADM Milling Co.) Number of Facilities = 39%
3. Continental Grain Port Facilities = 59%
4. Bunge
Source cited: **1997 Grain & Milling Annual* (Milling & Baking News)

Table 16 - flour milling [CR4 = 62%]*

	Mills	Daily capacity:
1. ADM Milling Co.=	30	311,300 cwts
2. ConAgra, Inc. =	29	264,900 cwts
3. Cargill Food Flour Milling =	18	223,000 cwts
4. Cereal Food Processors, Inc. =	9	82,900 cwts

Source cited: **1997 Grain & Milling Annual*

Table 17 - Dry corn milling [CR4 = 57%]

	Plants	24hr. grind
1. Bunge (Lauhoff Grain)	21	20,000
2. Cargill (Illinois Cereal Mills)	2	95,000
3. ADM (Krause Milling)	2	70,000

4. ConAgra (Lincoln Grain)	3	52,000
5. Quaker Oats	3	45,000

Source cited: *Corn: Chemistry & Technology* (1989).

Table 18 - Wet corn milling [CR4 = 74%]*

	Plants
1. ADM	4
2. Cargill	4
3. A.E. Staley (Tate and Lyle)	4 **
4. CPC	3

Sources cited: **Milling & Baking News*, 1990 Milling Directory. **Census of Manufacturing.

Table 19 - Soybean crushing [CR4 = 80%]*

	Plants	States
1. ADM	19	12
2. Cargill	16	12
3. Bunge	8	5 **
4. AGP	6	3

Sources cited: **Feedstuffs* (9/22/97). **(Census of Manufacturing).

Table 20 - Ethanol production [CR4 = 67%]*

	*Mil.gal
1. ADM	750
2. Williams Energy Services	130
3. Minnesota Corn Processors	110
4. Midwest Grain Products	108
5. Cargill	100

Source cited: *www.ethanolrfa.org/prodcap.html.

Preliminary data on grain inspected by USDA for export, presented by Keith Collins, suggest the degree of concentration in U.S. grain and oilseed exports. Table 21 shows the share of export inspections accounted for by the four largest exporters as reported by the Federal Grain Inspection Service (FGIS) for their five main reporting areas over the period 1985 to 1998. In 1998, market shares of the four largest firms for the United States ranged from 47 percent for wheat to almost 70 percent for corn.

Table 21 - Share of grain inspected for export for the four largest firms
(percentage of total inspections)

Year	FGIS Reporting Area					
	New Orleans	Texas	Atlantic Coast	Great Lakes	PNW	Total
Corn:						
1985	78.8	97.6	95.9	81.0	98.8	60.9
1990	81.7	95.6	100.0	89.3	98.8	68.9
1995	75.3	91.1	100.0	93.2	100.0	68.0
1998	75.4	80.3	100.0	84.5	99.9	69.7
Wheat:						
1985	81.1	73.0	95.0	94.7	79.3	51.7
1990	85.9	90.3	100.0	92.5	84.1	51.7
1995	82.7	89.8	100.0	82.5	75.9	50.0
1998	72.4	78.7	100.0	80.5	85.6	47.4
Soybeans:						
1985	84.3	100.0	97.0	97.3	100.0	77.5
1990	71.4	100.0	100.0	100.0	99.5	69.0
1995	70.8	99.9	100.0	85.4	100.0	67.5
1998	71.2	100.0	100.0	66.7	100.0	61.9

Source: Collins, Keith.1999.

While the share of total U.S. wheat exports held by the four top firms has remained relatively constant over time, the U.S. corn export market has become more concentrated. The export share for soybeans of the four top firms declined over the period. The changes in aggregate U.S. market share may mask changes at a particular port and the fact that the four top companies for some markets may have changed from period to period. According to Collins, in general, those reporting areas where export volumes are large and growing tend to be less concentrated than reporting areas with smaller and declining volumes. For example, volume exported through the Atlantic Coast reporting area declined by about two-thirds over 1985 to 1998. The number of firms fell to four or less over the same period. Over the same period, the volume of soybean exported through the Great Lakes reporting area increased by over 123 percent and the share of inspected exports for the four largest firms fell from 100 percent in 1990 to 71 percent in 1998.

The FGIS inspection data may understate or overstate the level of concentration because intra-company exports are frequently shipped without being federally inspected. The data also do not account for marketing arrangements between companies that may allow one company to ship through another company's exporting facility.

Control of storage capacity has implications in some areas-export facilities, control of delivery points for Chicago, Minneapolis and Kansas City futures markets contracts, inland

or country elevators, and control of overseas grain handling facilities. While storage capacity is generally not limited to only a few firms at the national or state level, local markets may be serviced by only one or two facilities, potentially limiting farmers' storage and marketing choices and thus their net returns.

Data from federally approved warehouses show the market share for storage space at the state level (table 22). At the national level, the four largest firms accounted for almost 27 percent of total elevator capacity. While there is much variation across states, in general, concentration tends to be lowest in those states with the largest off-farm storage capacities.

Table 22 - Share of off-farm storage capacity for the four largest firms

State	Top four firms % of total *	State	Top four firms % of total *
Alabama	57.3	Montana	63.5
Arizona	85.2	North Carolina	31.3
Arkansas	20.2	North Dakota	18.7
California	41.4	Nebraska	15.2
Colorado	31.3	New Mexico	79.7
Delaware	21.3	New Jersey	0.0
Florida	29.9	New York	36.0
Georgia	20.3	Ohio	30.8
Iowa	12.7	Oklahoma	38.9
Idaho	32.2	Oregon	62.6
Illinois	19.2	Pennsylvania	6.7
Indiana	30.4	South Carolina	35.7
Kansas	48.5	South Dakota	26.6
Kentucky	30.4	Tennessee	24.5
Louisiana	48.5	Texas	19.5
Maryland	19.1	Utah	52.7
Michigan	32.1	Virginia	47.2
Minnesota	23.3	Washington	36.2
Missouri	24.7	Wisconsin	26.3
Mississippi	98.1	West Virginia	29.9
United States	26.7		

Source: Collins, Keith.1999.

An analysis of delivery points for the Chicago Board of Trade's wheat, corn and soybean futures market contracts shows that the top four companies account for more than 85 percent of the bin space available for delivery. Concentration may be higher (or lower) at given inland locations.

The table 23 shows estimates of the size of world markets in pesticides and seeds, and share of the U.S. market of plant biotechnology is provided.

Table 23 - World sales of top ten pesticides and seed firms

	Pesticides 1997 $ millions	Seeds 1997 $ millions	Plant Biotech 1998 % of U.S. market
Aventis group (Hoechst/Rhone-Poulenc)	4,554	-	8%
Novartis	4,199	928	4%
Monsanto	3,126	1,800	88%
Zeneca/Astra	2,674	437	-
DuPont	2,518	1,800	-
Bayer	2,254	-	-
Dow	2,200	-	-
America Home Products	2,119	-	-
BASF	1,855	-	-
Sumitomo	717	-	-
Group Limagrain	-	686	-
Agribiotech	-	425	-
Seminis/ELM	-	375	-
Sakata	-	349	-
KWS	-	329	-
Takii	-	300	-
Total	30,900	23,000	-
CR4	47%	23%	100%

Source: Brennan, Pray and Courtmanche,1999.

4.4) Concerns

Several implications follow from dominance of the agribusiness sector by a small number of firms as well as cross linkages among supply and processing markets. The major ones are:

- Producers lose the ability to earn a reasonable return on their investment when market competition disappears. Consequently, the producers' share of the retail gets smaller.

- Remaining companies increase market share and political power over governments that regulate the companies. According to Swenson[13] in the U.S. companies have benefited in many ways. Some of the largest corporations have gotten tax breaks or other government-incentives (unavailable to the average businessperson) in order to build and operate plants within a community. Corporate interests have also called on the government to weaken environmental standards and immigrant labor protections in order to allow them to reduce production costs.

[13] Swenson, Leland. President of the National Farmers Union, in his statement regarding agricultural concentration, presented to the Senate Agriculture Committee in January 26, 1999.

- Companies that dominate several different industries can afford to operate at a loss in one area in order to eliminate the competition. Once the competition is gone, the company is able to earn higher returns and then subsidize another operation to repeat the process in another industry.

- Multinational corporations can use their ability to control supplies in more than one country as an opportunity to drive down price, to the detriment of the producers in both countries. According to Swenson, an example of this occurred in 1997, when Cargill announced its intention to purchase soybean from Brazil for processing in the United States. The price to American producers immediately dropped, before any actual purchases occurred.

- As corporations increasingly control the market, they can dictate the conditions their suppliers must meet. Concentration within the transportation and grain sectors has resulted in strict requirements being placed on local delivery points for grain. The elevators that used producer money to build facilities for 50 unit trains, are now being required to build facilities for 100 unit trains. They are also being required to bid for cars, take them whenever they arrive, and have them ready for pick up or face fines for not being ready. However, the rail companies give no guarantee that the cars will be delivered or picked up on time (Swenson, 1999).

- Potential for linked oligopoly and monopsony - Firms recognize each others' market area and refuse to enter or compete vigorously in each others' dominant area. This has proven to be a noticeable consequence of interstate bank mergers. It seems increasingly likely in the area of agriculture[14].

- Limiting the number of firms in any sector reduces the incentive to engage in dramatic innovations in technology or marketing.

- Supply chains redraw the rural economic landscape. Production tends to concentrate in fewer places. Integrators source production inputs, including capital, far from where products are produced. Profits do not all stay in the local area, reducing the local impact.

- The market power makes possible some kinds of conduct that are rational self-protection by the firms. These actions achieve both protection and entrenchment of their positions in the market. Several types of conduct problems can occur:

  Strategic alliances - Non-merger collaborations among large firms allow them to coordinate their competition in order to create mutual power. The intended effect is to obtain a stronger market position. A few of these alliances might provide economically useful coordination if they create an efficiency enhancing joint venture to produce or distribute new products.

[14] - 2000 C*ompetitive issues in agriculture and the food marketing industry*. Hearing before the committee on Judiciary. House of Representatives,1999.

Power abuse in contracts - For many farmers, the increasing usage of contracts as a method of market exchange exacerbates some concerns with concentration. According to USDA's 1997 Agricultural Resource Use Study (ARMS) data, nearly one third of all farm sales were covered by production or marketing contracts in 1997. The coverage is closely related to farm size. Nearly two third of the very largest farms had contracts, and 44% of those farms' sales was covered by contracts. In contrast, only 16% of small farms had contracts, and contracts in turn covered only 20.9% of their production.

Contract use varies with commodity, being especially prevalent in hogs, poultry, cotton, and some fruits and vegetables. Contracts can provide a variety of benefits to farmers, processors, and consumers. They may allow farmers to reduce price risks, transferring the risks to processors. Holding a contract can may make it easier for a farmer to acquire debt financing. Contracting may allow processors to schedule a steady flow of the agricultural commodity through plants, improving capacity utilization and reducing processing costs. Contracts can provide incentives to produce higher and more consistent levels of product quality.

But poorly understood or designed contracts may create new risks. Increased use of contracts for some commodities may reduce cash market volumes enough to significantly increase cash market volatility (increasing price risks for noncontracting farmers); publicly reported cash market prices may also then become less reliable guides to market developments. In concentrated markets with only a few buyers, farmers worry that buyers may be able to use contracts as a tool of price discrimination, thereby exploiting the potential market power created by concentration. Contracts often have substantial non-efficiency motivation. If a producer can tie up a substantial segment of the existing supply under contract, it will be much more difficult for a new entrant to open up in the area because of the limited supply available. If a substantial segment of supply is controlled, it will destroy a workable transactional market; Rivalry can destroy the more efficient and flexible means of linking producers to processors.

Contracting is not inherently evil, but it can be used for a variety of strategic purposes if it does not take place in a well structured legal environment in which there is reasonable equality of bargaining power, limited incentive to engage in strategic behavior, and continuing transparency with respect to transactions. Contracts may combine with buyer concentration to allow buyers to exploit market power.

Abuse of intellectual property rights - As more and more of the R&D effort come from private sector firms rather than traditional public sector sources, and as more of the information dissemination system becomes privatized, individual firms have more potential to capture value from intellectual property. Firms have the potential to restrict access to new ideas and information to particular users, thus favoring some and excluding others from the technology or information necessary for them to be competitive. The problem is the expansive definition of the legal rights that patents and other intellectual property confer on their owners.

The legal systems developed to define and protect rights regarding new technology in plants and animals were defined in another time, in different contexts. Initial concepts

of intellectual property rights, including patent and copyright law as applied to agriculture, were developed in an era of domestic markets and national firms; a relatively large public sector research, development and information dissemination system; and a limited role of information as a critical resource. Nowadays, in a context of global markets and multi-national business firms; the shrinking role of the public sector in research, development and disseminating information; and the increasing importance of information compared to other resources as a source of strategic competitive advantage, these rights confer vast opportunities to exploit the user. This is true across the board in areas of high technology. By licensing rather than selling the idea, the owner can exercise comprehensive control over the scope and nature of the use made. In the concentrated markets of agriculture with the broad range of activities controlled by a single firm, these rights encourage a expansive and abusive exploitation of the user. Once one firm starts down this path, its rivals are forced to follow the same strategy. So, those rights as they were defined, in sectors with concentrated markets, induce exploitation.

If an input manufacturing industry is characterized by a monopoly or oligopoly structure, then the firm or firms may be able to exert market power and set the input price above its marginal cost. A firm may be able to exercise market power through a patent that gives it an exclusive right to use the new technology. A firm may also be able to keep the technology out of its competitor's hands by keeping key elements of the new technology secret. Restricting access to the patent inbred lines can also protect intellectual property in hybrid varieties.

Government policies affect a firm's expectations about the benefits and costs of research and technology transfer. Strict anti monopoly policies can reduce the size of a firms expected market and reduce its opportunities for economies of size and scope in research, reducing expected benefits. Anti monopoly policies can also stimulate research by increasing competition that may force firms to innovate to keep ahead of their competitors. Broad patents can increase a firm's expected benefits, but it may reduce spillovers of knowledge and technology to other firms. The primary goals of intellectual property rights and competition policies is to strike a balance between appropriation and competition.

4.5) Antitrust cases

The U.S. Department of Justice - DOJ and the Federal Trade Commission - FTC enforce the antitrust laws in the context of agribusiness consolidation. These enforcement agencies have institutional expertise in agriculture and competition issues, as well as rely on a variety of external sources for industry expertise and advice, including the USDA.

The Antitrust Division of the Department of Justice has challenged a number of significant mergers in the agribusiness sector, such as:

- the proposed acquisition by Monsanto of DeKalb Genetics Corporation, a 1998 acquisition in the biogenetics area . That acquisition, according to the DOJ Antitrust Division would have significantly reduced competition in corn seed biotechnology innovation to the detriment of farmers; Both companies were leaders in corn seed biotechnology and owned patents that gave them control over important technology. To satisfy the DOJ's concerns regarding how the merger would affect seed competition**,** Monsanto spun off its claims to agrobacterium-mediated transformation technology, a recently developed technology used to introduce new traits into corn seed, such as insect resistance, to the University of California at Berkeley. Monsanto also entered into binding commitments to license its Holden's corn germplasm to over 150 seed companies that currently buy it from Monsanto, so that they can use it to create their own corn hybrids.

- the proposed acquisition by Cargill of Continental's grain business, which would have significantly reduced competition in the purchase of grain and soybeans from farmers in various local and regional markets. In July 1999, the DOJ Antitrust Division challenged the Cargill/Continental Grain merger as originally proposed. The concerns were that the proposed transaction would have depressed prices received by farmers for grains and soybeans in certain regions of the country. To resolve the competitive concerns, Cargill and Continental agreed to divest a number of grain facilities throughout the Midwest and in the West, as well as in the Texas Gulf. Cargill and Continental operate nationwide distribution networks that annually move millions of tons of grain and soybeans to customers throughout the U.S. and around the world. In a number of them, competition would be adversely affected if the assets of the two firms were merged. The concerns included the monopsony issue, regarding competition among the two firms as buyers of grain and soybeans from farmers and other suppliers. The lessening of competition resulting from the merger would have resulted in farmers being anticompetitively forced to accept less money for their major crops than before the merger. Thus, among the required divestitures, the Antitrust Division insisted on divestitures in three different markets where both Cargill and Continental currently operate competing port elevators, to preserve the competition that currently exists for purchasing the grains and soybeans of affected producers: (1) Seattle, where the elevators compete to purchase corn and soybeans from farmers in portions of Minnesota, North Dakota, and South Dakota; (2) Stockton, California, where the elevators compete to purchase wheat and corn from farmers in central California; and (3) Beaumont, Texas, where the elevators compete to purchase soybeans and wheat from farmers in east Texas and western Louisiana. Also required were divestitures of river elevators on the Mississippi River in East Dubuque, Illinois, and Caruthersville, Missouri, and along the Illinois River between Morris and Chicago, where the merger would have otherwise harmed competition for the purchase of grain and soybeans from farmers in those areas. Due to the concern that the merger would have anticompetitively concentrated ownership of delivery points that have been authorized by the Chicago Board of Trade (CBOT) for settlement of corn and soybean futures contracts, the Illinois River divestitures were required, and an additional divestiture of a port elevator in Chicago. The futures markets delivery points would otherwise have been under the control of Cargill and one other firm, which would have increased the risk that prices for CBOT corn and soybean futures contracts could be manipulated. Moreover, the

divestiture of a rail terminal in Troy, Ohio was required, and Cargill was prohibited from acquiring the rail terminal facility in Salina, Kansas, that had formerly been operated by Continental, and from acquiring the river elevator in Birds Point, Missouri, in which Continental until recently had held a minority interest, in order to protect competition for the purchase of grain and soybeans in those areas.

- The proposed acquisition by Monsanto of Delta & Pine Land, which would have combined the nation's two largest cotton seed companies, reducing significantly competition in cotton seed biotechnology to the detriment of farmers. Monsanto abandoned its proposed acquisition after learning of the intention of the Antitrust Division to sue to resolve concerns about the anticompetitive effects of the proposal.

The Antitrust Division also investigates other forms of business behavior that may have anticompetitive effects. Such conduct may constitute an illegal restraint of trade or unlawful monopolization or attempted monopolization, including strategic alliances between agribusiness companies, joint ventures among suppliers, and misuse of intellectual property rights.

The Antitrust Division and the FTC have an understanding with the Department of Agriculture to assure that the agencies work together and exchange information relating to competitive developments in the agricultural marketplace. As part of this cooperation, the Department of Agriculture has provided significant assistance and expertise in the various agricultural industries that have been the focus of their investigations.

References

Akhtar, Muhammad Ramzan. *An economic analysis of the U.S. retail fertilizer industry: impacts and policy implications at the regional level.* University of Minnesota. Ann Arbor, MI. 1993.

Brennan, Margaret F.; Pray, Carl E. and Courtmanche, Ann. *Impact of Industry Concentration on Innovation in the U.S. Plant Biotech Industry.* Paper presented in the International Consortium on Agricultural Biotechnology Research Conference, Italy. Food Marketing Policy Center, University of Connecticut. 1999.

Collins, Keith. Statement of the Chief Economist of the U.S. Department of Agriculture before the Committee on Agriculture, Nutrition, and Forestry. United States Senate. January 26, 1999.

Competitive issues in agriculture and the food marketing industry. Committee on the Judiciary. House of Representatives. Washington, D.C. 1999

Concentration in agribusiness. Hearing before the Committee on Agriculture, Nutrition, and Forestry. United States Senate. U.S. Government Printing Office, Washington, D.C. 1999.

Farris, Paul L. et al. Economics of grain and soybean processing in the United States. *Economics of food processing in the United States.* Academic Press, Inc. Department of Agricultural Economics. University of California. Davis, California. 1988.

Grains. Poduction.Processing. Marketing. Board of Trade of the City of Chicago 1973, 1977,1982.

Heffernan, William. Report presented in the *Competitive issues in agriculture and the food marketing industry* - Hearing before the Committee on the Judiciary. House of Representatives. One hundred sixth Congress. October, 29.1999

Hill, Lowell D. The structure and performance of the U.S. grain industry. *The grain sub-sector. Volume II: Australia, Canada and The United States.*. Agriculture Division - Technical Department. Latin America and the Caribbean Regional Office. 1990.

Koontz ,Stephen R. Department of Agricultural and Resource Economics. Colorado State University. Statement in the hearing before the United States Senate. April 2000.

Lauck, Jon. *American Agriculture and the Problem of Monopoly – The political economy of grain belt farming, 1953-1980.* University of Nebraska Press, Lincoln and London. Lincoln, NE. 2000.

Martinez, Steve. *From farmers to consumers: vertical coordination in the food industry*. Food and Consumer Economics Division, Economic Research Service, U.S. Department of Agriculture. Agriculture Information Bulletin no. 720. Washington, D.C. 1996.

Nelson, Lewis B. *History of the U.S. fertilizer industry.* Tennessee Valley Authority. Muscle Shoals, Alabama. 1990.

Raper, Kellie Curry. Staff Paper n. 98-58. Testimony at Michigan Senate Agricultural Preservation Task Force Hearing. Department of Agricultural Economics. Michigan State University.1999.

Royer, Jeffrey S., Rogers, Richard T. *The Industrialization of agriculture: vertical coordination in the U.S. food system.* Ashgate Publishing Company,Brookfield,Vermont. 1998.

Schweikhardt, David and Greenwalt, Bert. Market coordination in the U.S. rice industry: firm responses to changing demands for product quality. *Vertical relationships and coordination in the food system*. 1999. Physica-Verlag. Germany.

Swanson, Jeffrey A. *The U.S. fertilizer industry*. Institute of Agriculture, Forestry and Home Economics, University of Minnesota. St. Paul, Minnesota. 1987.

1992 census of manufactures. Industry series. Grain mill products. Bureau of the Census.1995.