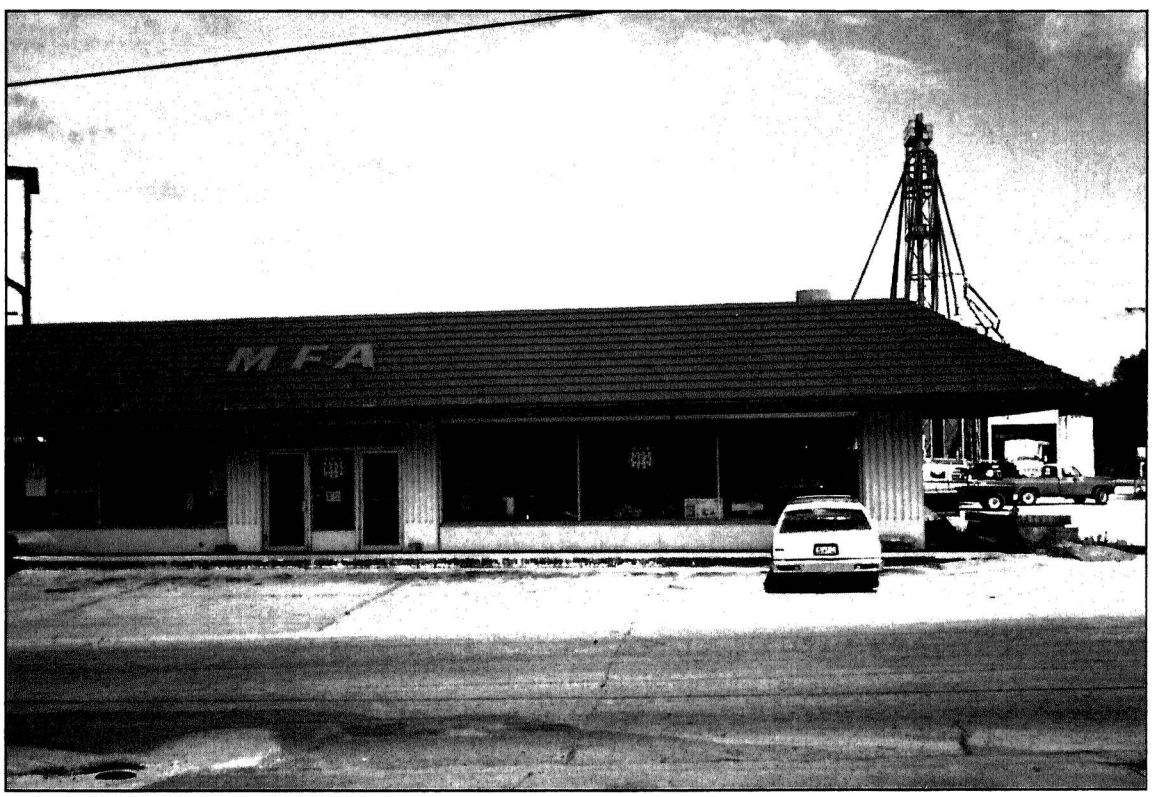
Southwest Missouri's

Changing Farm Supply Picture



MFA, Inc., Cooperative, Neosho

By Donald L. Van Dyne
and V. James Rhodes

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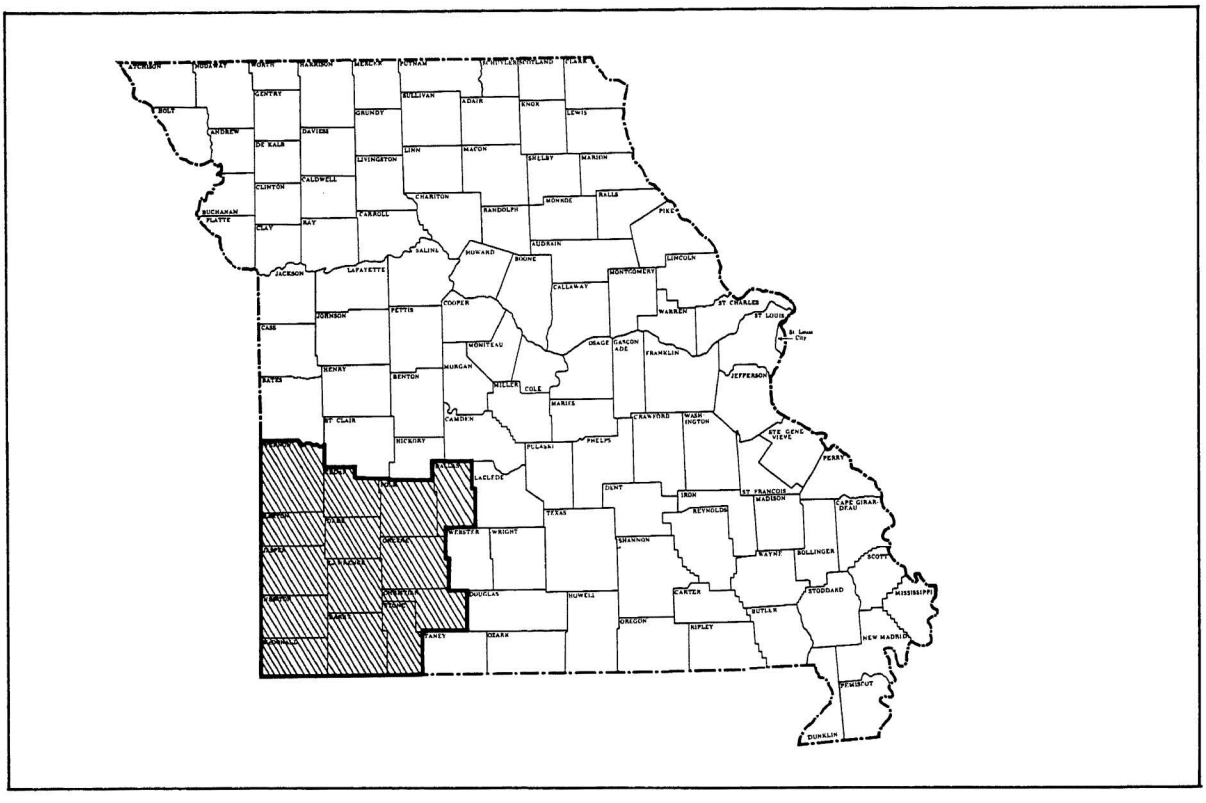
Figure 1—Fourteen county study area in Southwest Missouri



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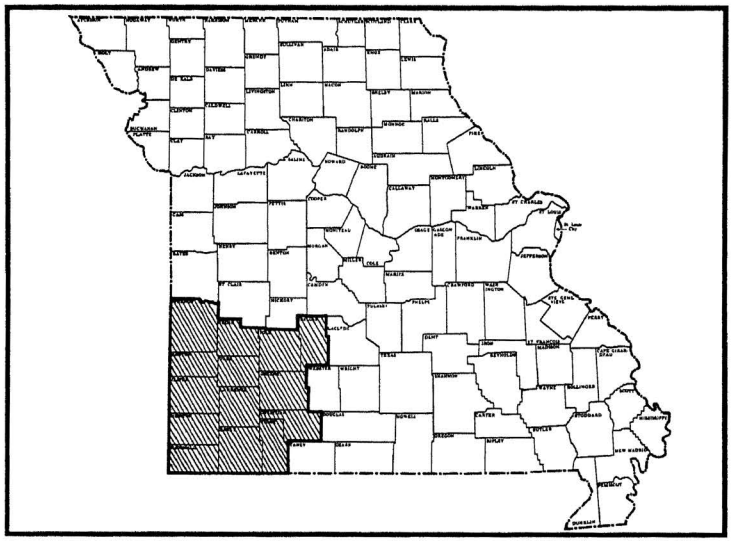
Contents

Introduction

An important way to improve business efficiency is through the improvement of individual management techniques. We have previously given attention to enterprise accounting as a means of helping farm supply managers improve their operations (1).



A complementary way to improve business efficiency is through improving the *system* of firms within a market area. Conceptually, economists can define the optimal size, number and location of competing firms within a given market. We have examined that issue in terms of a *system* of dry fertilizer blending plants in a recent paper (2). However, it is much more difficult to suggest a way of improving a real world system of firms. This paper begins by describing, as well as we can, the farm supply industry in a block of 14 contiguous counties in the southwest corner of this state (SWMO). The agricultural conditions affecting the total demand for the main inputs of feed and fertilizer are described. The numbers and locations of their retailers are developed. The extra costs arising from agribusiness overcapacity are suggested. Whether these costs represent inefficiencies or the costs necessary to maintain a competitive market depends upon one's point of view.

The purpose of this report is to discover an overall panorama that is not obvious to the market participants nor to the casual observer and then to demonstrate its effects to those involved.

The approach is to describe the current situation with farm supply firms in SWMO with considerable attention to trends. These provide a basis for anticipating future developments.

The farm supply industry of SWMO has been changing and will continue to change. One engine of change is the numerous developments in the agricultural base. Another is the process of "creative destruction" inherent in too many firms trying to serve a specific market.

Important developments in agriculture include changes in animal livestock and in cropping that influence total demand for feed and fertilizer. These, together with changes in the structure of farming, will affect the size of individual farm purchases and the services demanded. The growth of a vertically integrated poultry industry in the southern half of the region is an important example. Changes in the sizes and number of dairy and hog producers are other animal-related examples.

Rather continuous entry and exit are common in many industries. When demand is stable and the average firm is growing in size, the number of exits will have to exceed the entrants. However, if we apply the broad definition of entrants as new people entering by building or by the purchase of existing facilities, there has been considerable entry into the farm supply business in recent years in SWMO even while more exits were taking place.

The study area was chosen because of previous work in the area and not because it was considered to be unique in its farm supply industry. The 14 counties in SWMO includes a land area of 5.4 million acres, with 3.7 million acres in farms (Figure 1). About 1.2 million acres of cropland were harvested in the area in 1982. The area is approximately divided in northern and southern halves by I-44 which runs between Springfield and Joplin.

This report identifies: 1) selected changes in production agriculture in SWMO, 2) pertinent information about the largest farm supply inputs — feed and fertilizer, 3) changes in the structure of the farm supply businesses — especially of cooperatives, and 4) the general physical condition of cooperative and investor-owned-firm (IOF) farm supply facilities.

Production Agriculture

Production agriculture in SWMO is comprised of crops, livestock and poultry. The area south of I-44 is comprised mostly of dairy, beef, hog, and integrated poultry production. To the north beef and row crop dominate production, together with some dairy.

Crop and Livestock Production

The average acres harvested for major crops for 1986 and 1987 with changes from 1979-80 are included in Table 1. Two year averages are used to reduce the annual variation due to weather, farm program participation, and other factors. Note that only 13 percent of the total farm acreage was in feedgrains that might feed the area's livestock and poultry.

The average soybean acreage harvested from 1979-80 to 1986-87 was more consistent than any of the other major crops between the two periods. It decreased about 2.1 percent. Milo acreage was also relatively stable with a 5.4 percent increase. The acreage of wheat harvested was down 62 percent while that of corn increased about 11 percent, although it was a relatively small change at about 37,000 acres. The large reduction in wheat harvest was partially caused by wet fall weather in 1986 when farmers seeded only small acreages. Likewise, part of the increase in corn resulted because farmers planted part of the wheat ground to corn the following year.

The numbers of beef and dairy cattle were relatively stable during the 1980's in SWMO. The average inventory of almost 406,000 head of beef cattle on January 1, 1987, and 1988, was a decrease of 2.4 percent from 1979-80 (Table 2). The dairy cow inventory was down 13.6 percent from 1979-80, primarily because of the dairy buy-out program. This decline was slightly less than the 16 percent decline in dairy cow numbers during the 1980-87 period for the state of Missouri.

The largest change in livestock numbers occurred with a 43 percent reduction in hog and pig inventory numbers, from 1979-80 to 1986-87 (Table 2). However, according to feed plant managers, hog production changed significantly during this period with a rapid growth in the average size of the remaining producers. Much of the hog production in the early 1980's was in feeder pigs. Today the feeder pig industry in Southwest Missouri is virtually gone. Thus, the large change in hog inventory numbers likely is due to a substantial reduction in feeder pigs.

Poultry data are not available by county or subregion of the state in the 1986-87 data series. However, according to farm supply business managers, University extension personnel, and other agribusiness personnel, integrated poultry (broilers, turkeys, and egg laying operations) comprise the largest growth in production agriculture in SWMO. The primary firms include Tysons, Hudsons, ConAgra, Rogers, Simmons, Andersons, and Peterson Farms. All are involved with poultry, and Tysons also has vertically integrated hog production. Three integrator feed mills are located in the study area while several more mills are in nearby Arkansas.

The importance of poultry to SWMO is indicated by large poultry houses scattered over

Table 1:
Average harvested acreage 1986-87 and changes from 1979-80

Crop	Acreage harvested	Percent change from 79-80
Soybeans	255,600	-2.1
Corn	36,625	11.2
Wheat	93,850	-61.5
Milo	99,800	5.4

Source (3).

Table 2:
Average inventory of livestock, 1987-88

Type of livestock	Inventory	%change from 79-80
Beef cows	405,750	-2.4
Dairy cows	74,350	-13.6
Hogs and pigs	181,100	-42.6

Source (3).

much of the available open land south of I-44 between Joplin and Springfield. A new broiler processing plant located at Butterfield will eventually process birds from about 400 large houses. An estimated 150 houses have already been constructed to serve the plant. Each house has a capacity of 20,000 to 22,000 broilers, depending on weather, with a turnover of 6 to 7 flocks annually.

Farm Sales

Estimates of farm sales and other income for the study area are included in Table 3. Livestock and poultry comprise the largest component of farm income, ranging from a high of $480 million in 1981 to a low of $420 million in 1985. Data from the *1982 Census of Agriculture* list these percentages of total livestock sales: poultry, 23%; dairy, 30%; beef, 39%; and hogs, 8% (5, Appendix A). Although data are not available to document the increase in poultry production, it will represent an increasingly larger percentage of total farm income in the future.

The sources and percentage of income for 1986 were: livestock and poultry, 71%; crops, 16%, government payments, 4%; and rents and all other income, 9%. Net income was highest in 1986 at $119 million and lowest the previous year at about one-half that level.

Farm Production Expenses

Estimated farm production expenses in the 14-country area of Southwest Missouri range from $530 million in 1980 to $499 million by 1986 (Table 4). Feed and fertilizer comprised $169 million, or about 32 percent of total production costs in 1980. By 1986, feed and fertilizer expenses of farmers were an estimated $136 million, or 27 percent of total expenses. Feed and fertilizer dollar sales decreased 20 percent during the 1980-86 period.

Thus, feed and fertilizer accounted for fewer dollar sales and also a smaller percentage of total farm production expenses in 1986 than in 1980. Reduced fertilizer dollar volume by farmers resulted from fewer crop acres planted and cheaper unit fertilizer prices. Reduced dollar feed purchases resulted from less expensive feed prices because of large grain surpluses. Actual tonnage figures are unavailable.

The "all-other" category comprises the largest component of farm production expenses. Included in this category are literally all expenses of farmers that are not included elsewhere. The total increased $19 million during the 1980-86 period. In 1980, all other expenses represented 45 percent of total expenses, but increased to 52 percent by 1986.

Feed

With the concentrated livestock and poultry industries in SWMO, feed is the single most important farm supply in total sales volume. The last year that both dollar sales and tonnage data are available for feed is 1982. That year an estimated 623,000 tons of commercially mixed formula feed were sold in the 14-county area for $97.15 million (5). Average cost of feed was about $155 per ton. Estimated feed sales reported by the Bureau of Economic Analysis (BEA) were $132 million in 1982 (4). Some of the difference between the two data sets for feed

Table 3:
Estimated sales and income for a 14 county area of SWMO, 1980-86

Category	1980	1981	1982	1983	1984	1985	1986
	----------		*(Million dollars)*				----------
Sales							
Livestock	464	480	430	470	444	420	431
Crops	71	105	96	101	99	99	96
Other income							
Government payments	14	21	7	15	35	15	25
Rents & all other income	71	82	81	73	72	59	54
Net income	101	102	47	58	74	61	119

Source (4).

Table 4:
Farm production expenditures for a 14-county area of SWMO, activity for selected years

	1980	1981	1982	1983	1984	1985	1986
	(Million dollars)						
Feed	126	132	132	163	136	118	105
Fertilizer & lime	43	44	35	35	36	34	31
Petroleum	26	31	28	28	26	24	18
All other	241	292	293	299	303	282	260
Total production costs	530	595	577	613	588	545	499
Feed, fertilizer, & lime	169	176	167	198	172	152	136
Feed, fertilizer, & lime*	32	30	29	32	29	28	27

*Percent of total production costs. Source (4).

sales is due to differences in counting methods. The BEA includes some feed that is excluded by the Census.

Census data includes complete rations, supplements, concentrates and premixes. Feed items excluded are soybean meal, cottonseed meal, grain, and other items purchased separately by farmers who mill their own rations. Thus, most of the dairy feed is included in both sets of cost data. Also, most hog feed is included in the BEA data. However, much of the hog feed is not included the Census data because farmers prepare their own rations.

Types of Feed

Responses of nine area co-ops indicated that 62 percent of the feed sold was for dairy and 23 percent for beef. Hogs accounted for about 10 percent, and all other types of livestock and poultry consumed about 5 percent. These numbers are simple averages of responses from managers and are not weighted by the quantity of feed sold by each of the nine co-ops represented. We believe that the percent of each type of feed sold by investor owned firms (IOF) is similar to that of cooperatives.

Responses from managers also indicated that two thirds of their feed volume was sold in bulk, with the remainder being sold in bags. Furthermore, of all the bagged feed sold, 84 percent was a complete ration — that is, no further blending or mixing was necessary before feeding to livestock or poultry. Again, these are simple averages of managers' responses and are not weighted by feed volume.

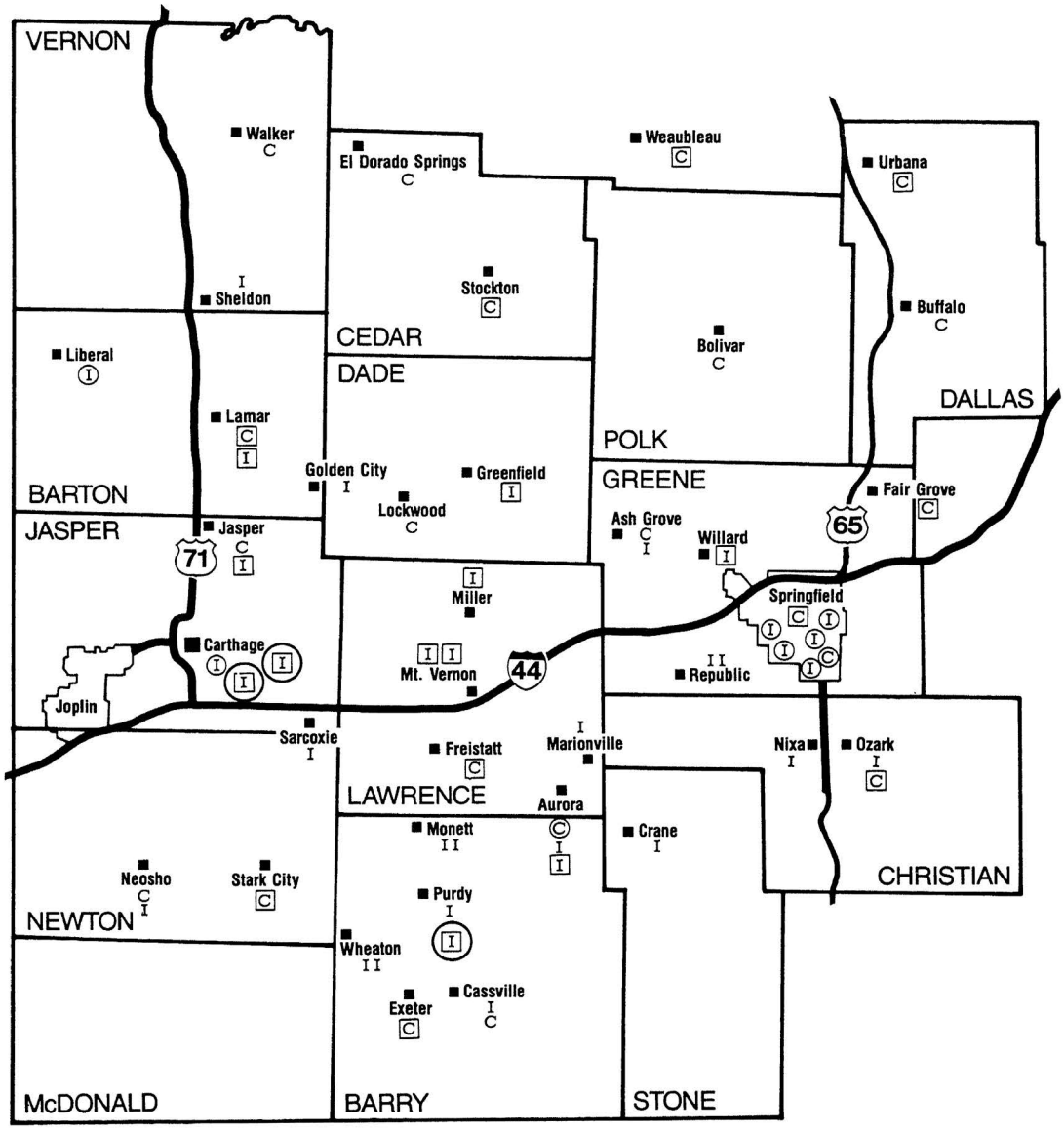
Feed Firm Locations

Firms that provide feed service in the study area are identified in Figure 2. Six large mills are located in Springfield, one in Aurora, one in Carthage, and one in Liberal. Another located in Joplin produces only pet food and is not included in this analysis. Three additional large mills are owned by integrated poultry and hog operations with two being located in or near Carthage and one near Purdy. The Arkansas mill used by Georges for broilers in Missouri is not included. Approximately 27 smaller mills are located throughout the area. An additional 18 feed outlets sell bagged and/or bulk feed but do not have milling facilities. Thus, we identified 54 places that either manufacture, mill, sell, or deliver feed, excluding the three vertically integrated feed mills.

Feed facilities located around the border of the 14-county region move some of their product outside the area. Likewise, firms located outside the area sell feed within the study area. Generally, we believe that feed moving into and out of the area should be approximately neutral for the small mills. However, a large net movement comes into the area from large mills outside it, as explained in the next section.

Some feed outlets with no storage facilities take telephone orders and deliver from central mills directly to farmers. Also, some co-ops and IOFs that have mills at their locations still buy most of their complete rations from the larger mills. Thus, capacity is underutilized for many of the smaller mills. This is especially true for those facilities located in nondairy areas because of increased seasonality for nondairy feeds.

Figure 2—Feed mills and outlets in a 14 county area of Southwest Missouri, 1988.



Legend

Mill and feed sales

C = Co-op

I = IOF

Feed sales - no mill

C = Co-op

I = IOF

Wholesale and direct sales

Ⓒ = Co-op

Ⓘ = IOF

Integrator feed mill

Ⓘ

Source (On site visits with owners, managers and employees).

A factor which could have implications for future farm supply business in SWMO is the changing ownership of the larger feed mills in Springfield. Three of the six large mills are now owned by the same firm. Central Soya purchased Tindle Mills in 1987, which in turn, purchased Lipscombs mill in 1988. MFA, Incorporated, owns large feed mills in Springfield and Aurora. They also have a mill in Lebanon (east of Springfield and the study area) and one in Butler (just north of the study area). Both provide some feed to parts of the 14 counties, but are physically located outside the study area.

The larger privately-owned feed mills are increasing the percentage of total feed sold directly to individual farmers, thus bypassing local IOF or co-op farm suppliers. The largest mill in Springfield currently sells one fourth of its feed output direct to such customers. Other large mills sell from 5 to 10 percent of their total feed output directly — mostly to large producers within a 75- to 100-mile radius of Springfield. Managers of the larger mills indicated the trend toward direct selling is increasing, but direct selling is still a relatively small percent of total feed volume in the area.

The smaller mills generally prepare some of their own feed (both bulk and specially formulated ration bagged feed) and rely on the larger mills for a large portion of the bagged feed and complete rations. Many of the feedmills owned by the local co-ops are old and require considerable regular maintenance and repairs to remain operational.

Feed Moving into and out of SWMO

In addition to feed manufactured or milled in the area, feed also is imported from other areas (and exported from the area). A pictorial of feed movement is included in Figure 3. Since SWMO is a grain-deficit area, most feed moves into the area, either as raw feed ingredients, premix, protein supplement, or complete ration. Feed imports are typical for the dairy and poultry industries. The grain is imported from the north and northwest. Immediately after harvest, grain generally comes from areas closest to SWMO, thus minimizing transportation costs. As the marketing year progresses, grain moves from more distant locations such as northern Missouri and southern Iowa. Oats come from as far away as North Dakota.

Complete ration feed also moves into the area. Farmland locals import feed from Afton, Oklahoma; Muncie, Kansas; and Centralia, Missouri. Nutrena, Purina Mills, and Kent Feeds (complete ration, supplements, premixes, etc.) are imported from Kansas City, St. Joseph, Marshall, and other locations. A complete inventory of shipping points, plus types and forms of feed was beyond the scope of this study.

Feed moves into the area by both truck and rail. With deregulation, smaller firms seem to have more difficulty than larger companies getting rail cars and favorable freight rates. This is especially true during prime harvest periods when rail cars are typically in high demand.

Feed also is exported from SWMO by the larger mills in Springfield. As previously mentioned, complete rations typically move less than 100 miles. However, bagged feed in trailer truck load or rail car lots move south to Texas, Louisiana, and Mississippi; east to Illinois; west into Kansas and Oklahoma and north as far as I-70. With closer distances, feed typically moves by truck while more distant locations are served both by rail and truck. Some backhauling is done when trucks are involved.

Fertilizer

Fertilizer Volume

Fertilizer use in the 14-county area of SWMO during the past few years has been somewhat erratic, because of both economic and climatic factors. Annual use has ranged from 162,000 tons in calendar year 1986 to almost 200,000 tons in 1987 (Table 5). Fertilizer use data compiled by the Tennessee Valley Authority for fiscal year 1986 indicated use of 159,546 tons. Thus, this seems quite consistent with use reported by the *Missouri Fertilizer Tonnage Reports* for the calendar year (6).

The relatively high use in 1987 stems from favorable weather throughout the year so that farmers could apply fertilizer virtually whenever they wanted. Also, favorable earnings from the dairy buy-out program, high beef prices, and other positive economic factors were all important in higher than average rates of fertilizer usage.

In 1986, the wet fall prevented most farmers from seeding wheat, which reduced the amount of fertilizer used not only for wheat, but also for pastures. Thus, some of the fertilizer that would normally have been applied on wheatland in fall 1986 instead was purchased in 1987 for

Figure 3—Feed movement into and out of study area.

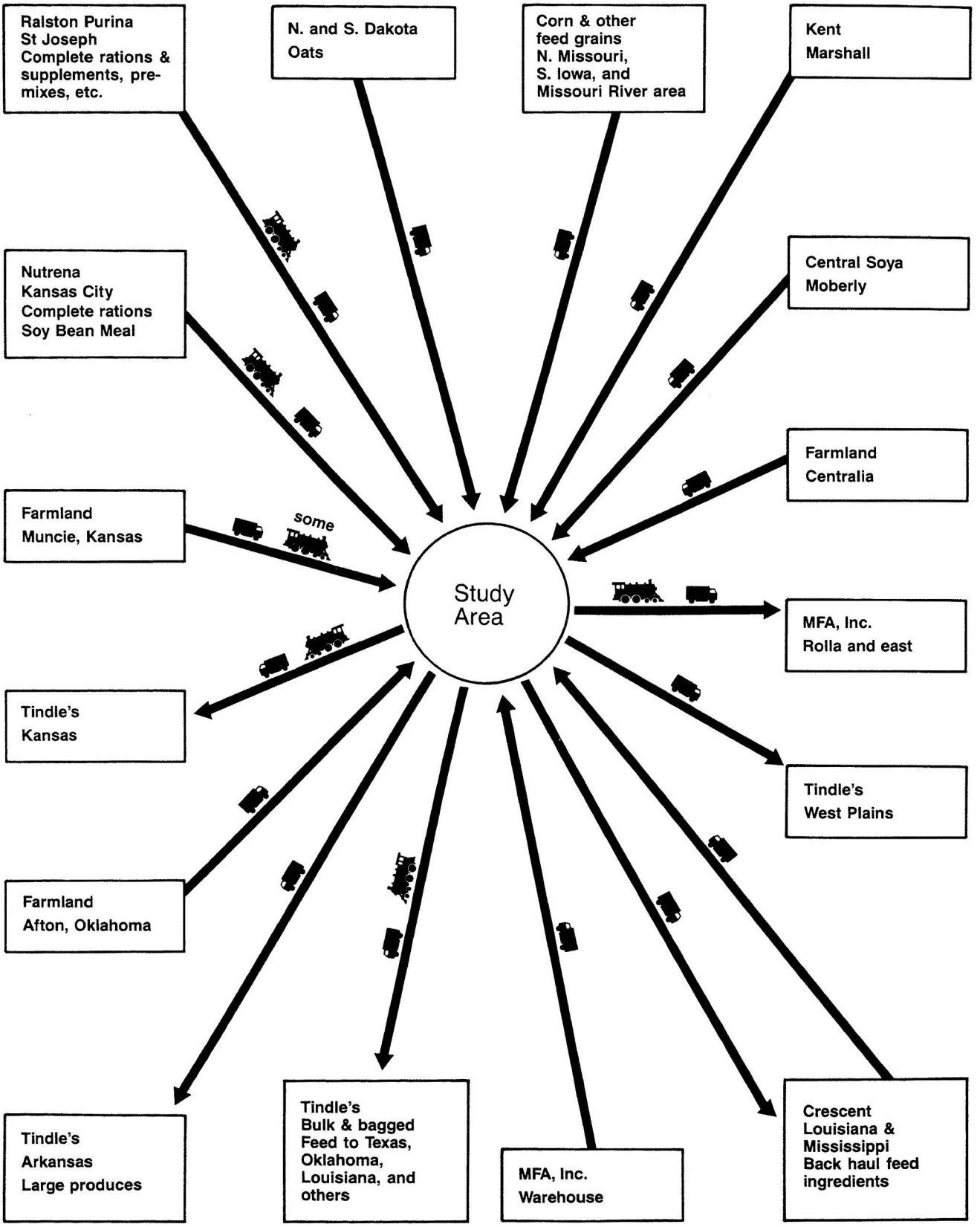


Table 5:
Fertilizer utilization in a 14-county area of SWMO, 1983-87

Year	Tons of fertilizer
1983	180,491
1984	167,379
1985	181,500
1986	162,482
1987	199,900

Source (6).

spring crop planting, thereby explaining some of the reduction in fertilizer sales in 1986 and increased sales in 1987.

According to managers and owners, most fertilizer sold in SWMO is dry. They also indicated that liquid fertilizer is used mainly north of I-44. While most managers agree that liquid is more expensive than dry fertilizer, farmers like it because various chemicals are applied in most applications, thus reducing the number of trips across the field. Anhydrous ammonia is sold only in the very north part of the SWMO area, near Nevada, which is the prime crop production section in the study area.

Fertilizer Plant Locations

Fertilizer plant locations as of 1988 appear in Figure 4. Forty plants were operating in the area, plus two large manufacturing plants located in Joplin. (The Iantha-Irwin plants are operated as a single entity.) The 40 plants are operated by IOF's, MFA, Inc., Farmland and local co-ops. Twenty-three plants are owned by cooperatives with the remaining 17 being owned by IOF's. In addition, two large fertilizer manufacturing plants — one privately owned and one owned by a cooperative — are located in Joplin.

With 40 facilities in the area and a total volume of 199,900 tons, an average of almost 5,000 tons per plant were sold in 1987 (Table 5). Obviously, not all firms are of equal size. However, on-site visits identified that most of the plants in the area are in the 1,500- to 2,500-ton storage capacity range. Thus, the average number of turns should be in the two-to-three range.

Both cooperative and IOF fertilizer plants in SWMO appeared to be very well maintained. Generally, they are in much better condition than feed milling facilities. Buildings and equipment for fertilizer operations appeared to have had regular maintenance. Although most appeared to be fully depreciated on an income tax basis, they should be fully serviceable well into the future. Fertilizer delivery buggies, truck nurse delivery vehicles, and other rolling stock were in various stages of serviceability. Most are owned by the fertilizer outlet; however, some of the very expensive, flotation-type truck spreaders are owned by private individuals that provide delivery-application services for a fee, normally around $2.50 to $3.50 per acre.

Fertilizer Moving into SWMO

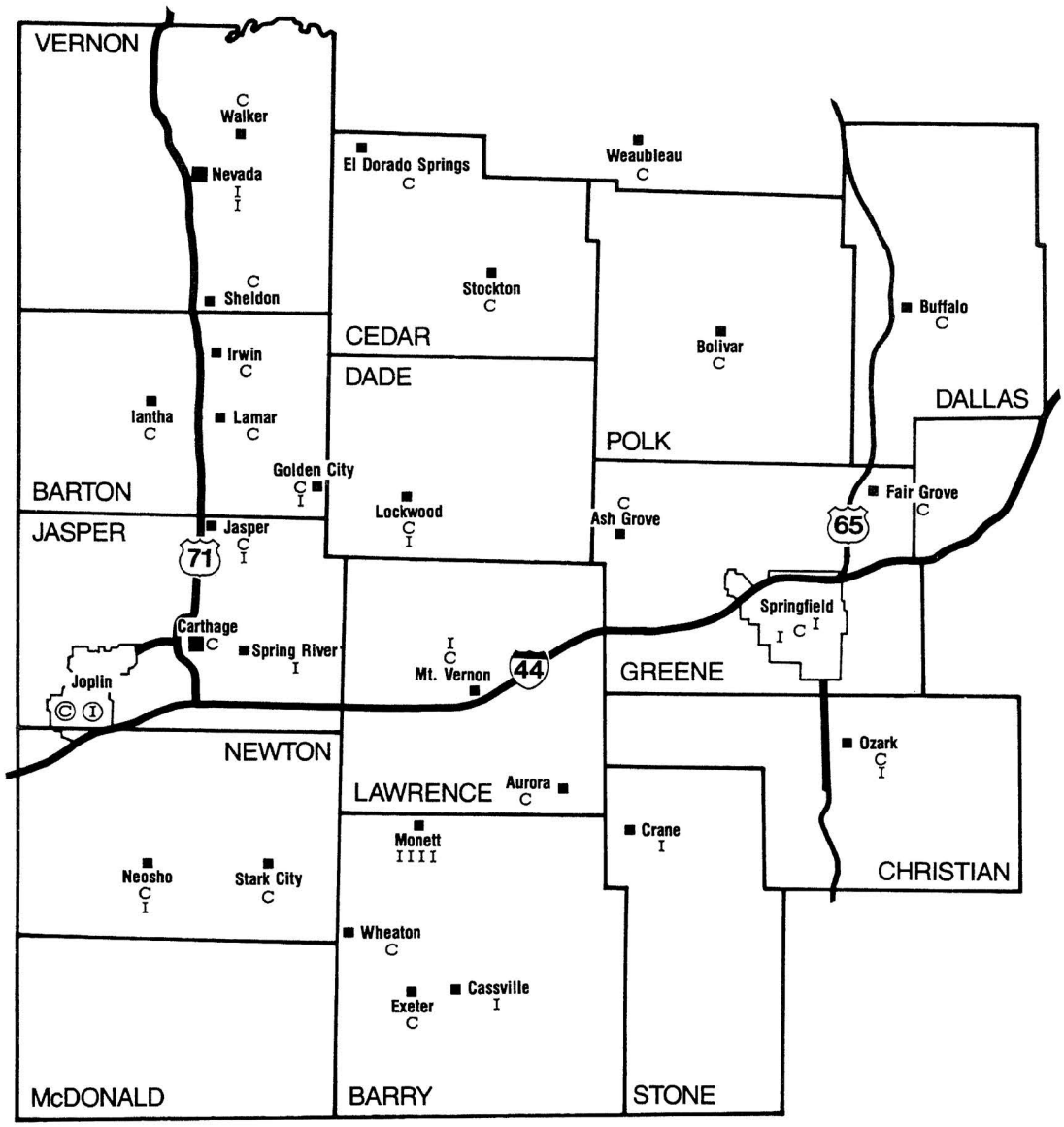
Fertilizer moves into SWMO both by truck and by rail. Phosphorous typically comes from Florida, moving by barge up the Arkansas River where it is off-loaded onto truck or rail for movement into SWMO. More recently, some phosphorous has been coming from Idaho, primarily by rail. Potash mostly comes from Carlsbad, New Mexico, and is usually delivered by rail. Nitrogen sources are Nebraska and Oklahoma, with some being produced in Joplin, Mo.

The method of transport depends on the season, whether the bulk plant is located on a rail line, and the preferences of plant managers. In off-season, most fertilizer moves by truck because managers want to minimize inventory. They generally want to have no more than 5 percent of their total capacity filled. Truck delivery is usually a backhaul for those that have delivered grain to south Missouri or northern Arkansas. Thus, delivery fees charged by most truckers for the backhaul are quite competitive to those of rail.

Rail car capacity is normally about 100 tons. Thus, a carload is more than most managers want in off-season. While some managers had praise for good rail service, others were highly critical of both service and delivery charges. Timing is also important in delivery. Several managers indicated that it took about 10 days from order until rail delivery. When a manager is ordering well in advance to prepare for a busy season, time is of minimal importance. However, in busy seasons, quick delivery is usually quite important and can normally be arranged by truck within a day or less after ordering.

Several managers prefer rail because they get a large volume of product at a time — often 3 to 5 cars — which can be unloaded by plant personnel when convenient. This is particu-

Figure 4—Fertilizer plant locations in a 14 county area of Southwest Missouri, 1988.



Legend

Fertilizer outlet

C = Co-op

I = IOF

Fertilizer manufacturing

Ⓒ = Co-op

Ⓘ = IOF

Source (On site visits with owners, managers and employees).

larly important when going into peak seasons. With trucks, unloading has to be done almost immediately when the truck arrives. With deregulation, managers of larger facilities seem to have had better "luck" than those managing smaller firms in getting good service and good rates with rail lines.

Agribusinesses in SWMO

This section focuses on the agribusiness community in Southwest Missouri, including changes during the past few years and the perceived ability of the firms to efficiently provide service in the future. Most of the analysis is based on records of locally-owned farmer cooperatives because data generally are available from them, but not from the IOFs. However, we believe that in a competitive market such as that in SWMO, IOFs generally should have similar financial performance.

The Balance Sheet

Changes in the general "financial health" of 21 locally-owned farm supply co-ops in SWMO are presented in Table 6. Data are presented for fiscal years 1983, 1986 and 1987. The same firms are included for each of the three years and include any facilities that were purchased during the period by any of the 21 locals. Assets, liabilities and equity all decreased during the 83-87 period — which essentially indicates a "downsizing" for the co-ops in total. Net returns (savings) were essentially the same in 1987 as in 1983 after being negative in 1986.

Of particular importance is the fact that assets decreased by 17 percent, at least for the 21 locals studied. This indicates that plants and equipment have either been sold to reduce debt or have depreciated without replacement. Both situations result in locals either no longer having facilities and/or equipment to provide service in the future, or having poorer quality facilities which could result in additional breakdowns, service interruptions, etc. Down sizing makes sense in the aggregate but may reduce the ability of any single firm to be competitive.

Liabilities were reduced almost 38 percent during the 83-87 period. Thus, reduced liabilities plus lower interest rates significantly reduced the aggregate cost of servicing debt.

Sales were reduced from $70 million in 1983 to $55.15 million in 1987, or about 21 percent during the 4-year period. Initially, this seems like a reduction in market share for the co-ops. However, the generally lower prices of grain and inputs indicate that the co-ops probably maintained their *physical* sales volume. The lower total sales dollars reflect lower unit prices for the major items sold by co-ops. The average annual U.S. price of soybeans and wheat decreased about 30 percent during the 1983-87 period; corn prices in 1987 averaged only half of those in 1983 (Table 7). Dairy feed, the predominant feed in SWMO, was priced almost 20 percent less in 1987 than four years earlier — primarily because of depressed grain prices.

Sales

Departmental sales data indicate that $53.7 million in farm supplies were sold by 24 locally-owned farmer cooperatives in FY-1987 (Table 8). This includes data from the 21 firms listed above plus an additional three firms for which

Table 6:
Changes in financial data for 21 locally-owned farmer cooperatives in SWMO, selected years.

	1983	1986	1987	Change 83-87
	---- Million dollars ---			*-- %--*
Assets	23.95	20.54	19.79	-17.4
Liabilities	8.91	6.25	5.53	-37.9
Equity	15.04	14.28	14.26	-5.2
Net savings	0.48	-0.26	0.54	12.5

Source: (Audit reports for the respective years and cooperatives).

Table 7:
Changes in unit prices & costs for selected items in the U.S., 1983 and 87.

Item	1983	1987	Change
	-- Unit price --		*--%--*
16% dairy feed ($/ton)	191	155	-19
Fertilizer (13-13-13)	180	164	-9
Corn ($/bu)	3.40	1.70	-50
Soybeans (/bu)	7.87	5.50	-30
Wheat ($/bu)	3.45	2.42	-30

Source: Average U.S. annual prices for the respective years. (7).

Table 8:
Departmental sales volume for 24 local co-ops, FY-1987

Department	Sales ($1,000)	Percent of total
Feed	27,675	51.6
Fertilizer	13,664	25.4
Farm supplies	7,765	14.5
Chemicals	582	1.1
Petroleum	1,440	2.7
Miscellaneous	2,526	4.7
Totals	53,652	100.0

Source: Individual locally owned cooperatives audit reports, FY-87.

Table 9:
Monthly sales data for feed, fertilizer, feed and fertilizer combined, and total farm supplies for four locally-owned farmer cooperatives in SWMO, 1987

	Percent of total annual sales for each sales category			
Month	Feed	Fert	Feed & Fert	Total sales
January	9	3	7	5
February	9	8	8	6
March	8	24	14	9
April	7	23	13	8
May	7	11	8	7
June	7	6	6	9
July	7	1	5	6
August	7	1	6	5
September	9	7	8	7
October	9	12	10	18
November	11	3	8	14
December	10	1	7	6
Totals	100	100	100	100

Source: (Audit reports for selected cooperative firms).

1983 data were unavailable. Feed sales were the largest single source of sales for the co-ops, comprising almost $28 million or 52 percent of total sales volume. Fertilizer sales comprised 25 percent of total sales volume. Thus, feed and fertilizer together comprised 77 percent of total sales volume. These data exclude petroleum sales of MFA Oil Co. and grain sales by the co-ops.

Comparing Tables 4 and 8 indicate that *locally-owned* co-ops have a very small portion of the petroleum business. If MFA Oil sales data were included, a much greater percentage of co-op sales would be attributed to petroleum products. The data in Table 8 also indicate that a significant portion of locally-owned co-op sales volume (15 percent) comes from general farm supplies such as hardware, fencing supplies and miscellaneous items. Previous work indicates that profitability of this department is questionable (1). While gross margins typically are in the 15 to 20 percent range, costs of providing the service are usually higher than for other types of farm supplies, thus, resulting in net departmental losses.

Economies of Diversification

Several of the farm supplies provided by most firms are seasonal. To the extent that a single firm can keep their resources busy throughout the year by providing a combination of these services, overhead (management, labor, facilities, and others) can be more fully utilized and thus more cost-effective. Hiring part-time labor during extremely busy periods helps to increase people utilization; however, many owners and managers are reluctant to do so because of the difficulty in finding qualified individuals who are willing to work on an intermittent basis.

In an effort to measure economies of diversification, monthly sales data were identified by the type of farm supply provided. Complete data, including grain sales, were available for four firms. The percent of sales for each month was calculated for 1) total sales, 2) feed sales, 3) fertilizer sales, and 4) feed plus fertilizer sales. If less variation exists with total sales than with feed and/or fertilizer sales, then economies of enterprise diversification may exist and unit costs of operation *should* be less than when each type of supply is provided separately.

Fertilizer clearly provided the most seasonality problems. It probably helps a bit to combine fertilizer with feed and other farm supplies rather than running it as a stand-alone business. Feed sales were more constant throughout the year than any other single type of farm supply or total farm supply sales, primarily because most feed is dairy and the demand is more constant throughout the year than with other

types of livestock (Table 9). The range in percent of total annual feed sales in any month was from 7 to 11 percent.

Fertilizer was the most seasonal of any single type of farm supply (based on sales data) because of peak demand during March and April with an additional peak demand in October. During the two spring months the percent of total annual fertilizer sales were 24 and 23 percent, respectively. Thus, nearly 50 percent of total fertilizer sales volume were in those two months. Large grain sales during the months of October and November caused a bulge in total sales in the fall.

These data are far too limited in time and scope to be conclusive. They do suggest that diversification in farm supply retailing does make sense to the extent that certain common resources can be shared throughout the year by different enterprises.

Retail Closures

During the past three years at least 23 cooperatives (co-ops) have closed their doors or been forced to merge with other firms (Table 10). Generally, recent financial records of the firms that have merged or closed are unavailable. However, normally the failing co-ops have had some combination of 1) high debt, 2) low (or negative) member equity and 3) decreasing sales.

Four of the co-ops that have changed ownership were taken over by MFA, Incorporated. Six co-ops have either been leased by or have merged with other local co-ops, and 10 have closed their doors. Three farm supply outlets have been taken over by Farmland Industries and are being operated directly by them.

Several currently operational co-ops in SWMO are carrying a high debt load and have experienced decreasing total sales volume during the past four years. Those firms that are in weaker financial condition generally have resisted efforts of the regional co-ops to either merge or to change operations in an attempt to further reduce costs or increase sales, or both.

Feed Firms

The two most important factors in efficient feed service are full usage of feed milling and/or manufacturing facilities and an efficient distribution system. Full use of facilities throughout the year results in the lowest unit feed cost

Table 10:
Farm supply business closings and changes in ownership in a 14-county area of southwest Missouri, 1985-1988

Date	Firm name/location	Acquiring firm
1986	MFA local/Cassville	MFA, Inc.
1986	MFA local/Neosho	MFA, Inc.
1988	MFA local/Ash Grove	MFA, Inc.
1988	MFA local/Fair Grove	MFA, Inc.
1985	MFA, Inc./West Plains	Closed
1988	MFA, Inc./Stockton *	Bolivar Farmers Exchange
1985	MFA local/Republic	Closed
1986	MFA local/Mt. Vernon	Closed
1985	MFA local/Carthage	Closed
1986	MFA local/Crane	Closed
1988	MFA local/Lamar	Chapter 7
1985	MFA local/Seymour	Closed
1986	MFA local/Crane	Closed
1986	MFA local/Greenfield	Closed
1986	MFA local/Walnut Grove	Closed
1987	MFA local/Dunnegan	Closed
1987	MFA local/Richland	MFA local/Lebanon
1987	MFA local/Ava	MFA local/ Mansfield
1985	MFA local/Weaubleau	Bolivar Farmers Exchange
1986	MFA local/Urbana	Dallas County Farmers Exchange
1987	Farmland local/Lamar	Farmland Industries
1987	Sheldon Grain & Feed	Farmland Industries
1988	McCurry Farm Supply Fair Grove *	Farmland Industries
1985	Stark City/Fmld local	Exeter Fmld local
1989	Farmland local/Monett	Mainstreet Feeds
1989	Farmland local/Monett	Branch at Mt. Vernon--IOF

Source (Information obtained by personal interview of farm supply owners and managers, University of Missouri extension personnel, the Missouri Farmers Association (MFA, Inc.), and Farmland Industries).
* Facility is leased, not purchased.

Table 11:
The number of co-op and IOF feed facilities located in SWMO, 1988

Type of feed facility	Number of locations Co-op	IOF
Manufacturing	2	7
Milling & retail	9	18
Feed store —no milling	10	8
Total	21	33

Source: (On-site visits to each firm in the study area).

Table 12:
The number of competing feed plants located within trade territories of base feed plants

Type of ownership in base feed plant	Average number of competing feed plants in trade area Co-op	IOF
Co-op	5.5	5.6
IOF	5.9	5.8

Source: (On site visits to each firm in the study area).

for a given size facility. Likewise, efficient distribution is necessary to minimize overall feed costs. Least cost distribution results when full loads are delivered and when little overlap of feed territories exists among dealers. From all indications, this is not the case in SWMO.

To quantify excess capacity and duplication of feed service, two measures were used to identify the degree of feed competition in the area. First, every known feed dealer in the 14 - county area was contacted and asked to define the dealership's perceived trade territory. Fifty-two feed mills, feed manufacturing facilities and feed stores were identified (Figure 2). Privately owned feed firms comprise 58 percent of the facilities with the remaining 42 percent owned by co-ops (Table 11). Boundaries for the trade territory were identified on a map for each firm providing feed service. The acreage in each individual feed plant's trade territories was identified. The acreage for each of the 45 firms providing feed service (excluding the nine manufacturing facilities) was totalled and related to total land area in the 14 counties. The total area of all perceived trade territories, excluding the large mills, was large enough to cover the available land area about four times. If the trade territories of the larger mills were included, the coverage would have been much greater.

The second measure of the duplication of sales territories of feed supply plants in SWMO was accomplished by selecting an individual feed plant and identifying the number of competing feed plants (co-op and IOF separately) that were located in their "perceived" trade territory. This task was done for every feed plant, both IOF and co-op, in the 14-county area.

For each co-op feed plant in the area, an average of 5.5 other co-op feed plants and 5.6 IOF feed plants compete in their trade territory (Table 12). Included are smaller feed milling plants and feed stores with no milling capability. The numbers exclude the six large mills in Springfield, the MFA, Inc., mill in Aurora, a privately owned mill in Liberal, Mo. and mills owned by the vertically integrated poultry and hog operations. For IOF feed plants, a slightly higher average number of competing feed plants existed, primarily because IOF firms generally had larger perceived trade territories.

At least 15 large feed mills (nine within the area) are manufacturing feed to be sold in SWMO, excluding those mills owned by vertically integrated firms. Most of the mills outside of the study area are located between the grain producing areas to the north or northwest and SWMO.

Most data indicate only dollar feed purchases by farmers or dollar sales by agribusiness firms. Without feed tonnage data, the volume processed through mills is unknown; thus, the percent of mill capacity utilized is unknown. However, estimates of feed consumption are derived for 1987 with the methodology included in Appendix B.

According to the estimate derived in Appendix B, about 635,000 tons of feed were sold in the 14-county area in 1987. This is relatively close to the 623,000 tons reported in the *Census of Agriculture* for 1982. While the number of hogs are down significantly, beef cattle numbers are relatively stable. The number of dairy cattle decreased almost 14 percent during the period, but average milk production (and thus feed consumption) increased enough to approximately offset the reduced inventory numbers.

Total feed production capacity for plants located in the area is unknown. Seven of the

Table 13:
Estimated costs of providing feed service with varying plant sizes and capacity usage

Annual plant capacity Tons	Annual fixed costs ($1,000)	Variable costs	Percent capacity utilization 100%	75%	50%
			------Average costs ($/ton) ------		
48,000	457	5.48	15.00	18.17	24.52
96,000	761	4.57	12.50	15.11	20.42

Source (8). Note — These plants include costs for a mixture of bulk and bagged feed with part of it being pelleted sales.

eight larger feed plants located in the study area are on the fringes. For instance, plants in Springfield probably sell nearly half their feed to outlets and farmers to the east, outside our study area, with the remainder going into the area. Likewise, for the two plants located near the Missouri-Kansas-Oklahoma border — some of the feed goes outside the study area.

Competition for feed sales in SWMO is high. Personnel from the large feed mills in SWMO indicated that they generally operated at about 50 percent of capacity. Capacity utilization is higher during the winter months when demand for beef feed increases. Likewise, according to mill owners and managers in the study area, most of the smaller mills also operate at about one-half capacity much of the year. Two smaller plants were identified that had particularly aggressive management with respect to feed sales. Their feed plants were almost fully utilized most of the year.

If most feed plants are operating at an average of about 50 percent, then closing half of them should allow the remainder to operate at near full capacity. Obviously, this is a simplification which excludes feed imported into the area from outside plants. Estimated costs per ton of feed produced with varying capacity utilization rates are included in Table 13. As capacity used decreases from 100 percent to 50 percent, unit feed production costs increase by almost two thirds. If reduced capacity is identified to be of a long-term nature, plant managers likely can reduce personnel or make other adjustments that eliminate some costs. Generally, however, it appears that the feed demand in SWMO could be satisfied by 27 plants, rather than the currently operational 54 plants.

Another alternative would be a greater reduction in the number of small plants with full utilization of the larger plants located in or out of the area. Longer deliveries are possible with full truckloads of feed. As the proportion of agricultural output from large farms continues to increase, the proportion of feed delivered directly from larger mills may be expected to increase.

When mills operate at full capacity, rather than 50 percent capacity, per ton savings could be in the $8.00- to $9.50-per-ton range, excluding any changes in ingredient prices (Table 13). With approximately 635,000 tons of feed used in SWMO annually, a savings of $5.6 million would be realized ($8.75 x 635,000 tons). Because trade territories already overlap so much, a reduction by half of the number of mills need not increase the average delivery distance. Hence, transportation costs may not be affected much, if at all, by a drastic reduction in the number of mills within the system. Therefore, we conclude that these substantial savings might be available to the area's livestock producers through closing approximately one half the area's mills without replacing them with new entrants.

Fertilizer Firms

A procedure similar to that for feed mills was used. We asked fertilizer plant managers to identify their perceived trade territories. All trade territories were aggregated and related to total land area for the 14 counties. Total area included in perceived territories was enough to cover the total 14-county area about 5 times. Forty plants were visited, with 23 owned by cooperatives and the remaining 17 privately owned (Figure 4).

We also measured market area duplication of fertilizer plants in SWMO identifying for each plant the number of competing plants (co-op and IOF separately) that were located in its "perceived" trade territory.

For each co-op fertilizer plant in the 14 counties, an average of 4.2 other co-op fertilizer

Table 14
The number of fertilizer competitors in trade territories of independently owned firms and farm cooperatives, 1988

Type of ownership in base fertilizer plant territory	Average number of competing fertilizer plants in trade	
	Co-op	IOF
Co-op	4.2	4.1
IOF	3.8	2.4

Source: (On site visits to each of the 40 plants in the study area).

plants and 4.1 IOF fertilizer plants were physically located in their trade territory (Table 14). For IOF plants, a smaller average number of competing plants exist, primarily because the IOF firms generally had smaller perceived trade territories.

The number of fertilizer competitors in perceived trade territories is less than with feed. This partly is because perceived trade territories for fertilizer tend to be smaller than for feed. Also, several fertilizer plants have closed during the 1980's; thus, more restructuring has already occurred within the fertilizer industry than within the feed industry.

Those firms that can sell fertilizer for the least cost generally have the best opportunity to remain in business in the future. Least cost service is a combination of buying raw materials for least cost (delivered to the plant), best management and minimum cost of providing service. Among other things, the latter is comprised of high utilization of facilities — both fixed plant and equipment as well as delivery equipment.

The number of times the fertilizer inventory turns annually is important because as volume increases, per unit fixed costs decline. Estimated fixed and variable costs of providing fertilizer service (with various size plants) are included in Table 15. As volume increases, fixed costs are spread among more units of product and unit costs decrease. For instance, a plant with a 1,000-ton storage capacity and a single turn of inventory annually results in a cost of about $37 per ton of fertilizer sold, excluding materials. With the same plant and an inventory turn three times annually, unit costs drop to $18 per ton, or less than half that with one turn. Similar cost savings occur with a higher number of turns in larger size plants. Most plants in SWMO are in the 1,000 to 2,500-ton storage capacity range.

Economies of plant size are somewhat offset by increased delivery costs. In a study of 24 counties in SWMO (including the 14 in this study) the average cost to cooperatives of providing fertilizer service is estimated at $28.40 per ton delivered to the farm gate (2). Included is a delivery charge of $7.79 per ton based on a rate of $0.16 per ton mile.

This study assumed: 1) that an average of 1.9 turns of inventory occurs annually with co-ops having one third of the total fertilizer market; and 2) that farmers could buy from two co-op plants — instead of about four — plus the IOF outlets. Information in Table 14 suggests that co-ops had an average of about four other co-ops plus another 4 IOF fertilizer outlets physically located in their trade territories. Thus, farmers had numerous locations from which they could buy fertilizer.

Table 15:
Estimated costs of providing fertilizer service with varying plant sizes and varying number of turns

Plant capacity	Annual fixed costs	Variable costs	Number of turns annually		
			1	2	3
-Tons-	*--($)--*	*-($/ton)-*	*---------- ($/ton) ----------*		
1,000	28,506	8.50	37.01	22.75	18.00
2,000	53,879	8.03	34.97	21.50	17.01
3,000	75,180	7.47	32.53	20.00	15.82
4,000	95,729	7.13	31.06	19.10	15.11

Source (9).

Secondly, if each farmer had only one co-op source from which to purchase fertilizer (plus the IOF outlets), unit costs per ton decreased more than $3 to $25.31. These costs continue to assume an average of 1.9 inventory turns annually. Blending costs remain constant but delivery costs decrease substantially due to smaller delivery distances.

The final adjustment examined reducing plants in size such that average inventory turns for the co-op plants increased to 2.5 annually. Then further savings of $2.51 per ton were obtained. Thus, total savings to farmers could be an estimated $7 per ton as the result of these three structural changes, or a reduction of about 25 percent in the cost of providing fertilizer service. If fertilizer cost $150 per ton (including ingredients), the $7 reduction in costs represent a savings of about 5 percent.

These necessarily rough estimates indicate that fewer, more highly used plants would provide a more cost-effective fertilizer system for farmers in SWMO. However, many of the plants are owned by MFA, Inc. and by Farmland Industries. During the past few years, MFA, Inc., has closed some of their plants throughout the state. Results of the plant closings, according to management, is that farmers who have been served by a plant that was closed were largely unwilling to purchase from another more distant branch of their organization. Thus, even though economies of size do exist with larger size plants and plants with a larger number of turns annually do have lower unit operating costs, the resulting loss of business volume makes plant closings very costly. Farmers need to find a way to obtain a more efficient agribusiness *system* in order to increase their ability to compete with the crop, livestock and poultry producers of other states.

Competition From Vertical Integrators. Additional competition for fertilizer sales among existing plants will become more evident as vertical integration of poultry continues to move northward in SWMO. As firms expand, additional land will be necessary for disposal of manure and litter from poultry operations. Managers indicated that fertilizer plants located in northern Arkansas experienced significant reductions in sales volume as vertically integrated poultry firms expanded production.

Poultry vertical integration is concentrated in five counties in extreme southwest Missouri. Fertilizer use in those counties in 1986 was an estimated 35,285 tons, or about 22 percent of the total fertilizer used in the 14-county SWMO area in 1986. While it is not a large percentage of total fertilizer in the study area, it is quite important to local plants.

The potential for manure and litter to replace commercial fertilizer depends on the nutrient quality of the manure and the total quantity of manure relative to the available land area for spreading it. For instance, in 1987 broiler manure and litter was being sold for $60 per truck load by an integrator located in Barry County. In 1988, a similar load was being sold by the same firm for $30. Thus, as production becomes more intensive, product value likely will continue to decrease and may even require payment by the integrators for disposal. The possible volume of manure and litter that might be produced by houses that serve a single processing plant is estimated in Appendix C.

General Condition of Facilities

The physical condition of feed and fertilizer facilities for plants in SWMO is quite adequate to continue operation well into the future. Fertilizer plants as a whole are in better condition than feed plants. Pictures of representative plants located in SWMO follow in the pictorial section. It includes both IOF and cooperative plants, as well as some that have closed in recent years.

Conclusions

The primary fact for farm supply firms in SWMO, both co-op and IOF, is that more change is forthcoming. That rate of change will be directly related to changes in production agriculture. If the move toward fewer and larger commercial farms is accelerated, changes in the farm supply system will be faster. In this instance, more supplies will move from manufacturers or large warehouses directly to large farmers, which bypasses the traditional full service farm supply system.

Other factors of importance include:

- The dollar volume of feed sales is more constant throughout the year than any other type of farm supply while that for fertilizer has the greatest variation.

- The trend toward increased feed sales from large feed plants directly to larger farmers will continue.

- Feed manufacturing and milling plants appear to be operating at about 50 percent of capacity during much of the year. Operating at capacity, rather than one-half capacity, could reduce feed costs by $8.00 to $9.50 per ton.

- Small feed businesses who do much of their own milling will continue to face very stiff competition and will be at more of a disadvantage in the future.

- Much of the structural readjustment of fertilizer distribution in SWMO has already occurred.

- Smaller fertilizer plants likely will continue to exist, especially if increased efficiencies can be obtained.

- The future structure of fertilizer supply firms in SWMO (north of I-44) should remain similar to that of today unless significant and unexpected changes occur in cropping patterns.

- Managers of fertilizer plants in extreme SWMO, where integrated poultry and hog operators are growing, believe the volume of fertilizer sales in the future will be severely reduced because of the increasing volume of manure and litter that will be disposed of, on farmland.

- Economies of diversification appear to be realized by those firms that handle several different types of farm supplies. If other things are equal, fertilizer plants ought to be integrated into firms providing other farm supplies.

- Cooperatives have sizable market shares in SWMO but they are not a dominant force. Given the low level of earnings and recent exits of locally owned cooperatives, the remainder have a diminishing role. MFA, Inc., has a sizable presence in fertilizer through its numerous centrally managed plants.

- Several small and highly leveraged co-ops will go out of business or be purchased by other firms soon.

- Alternative types of farm supply sales and alternative patrons generally have not been identified by most local co-ops.

- The current system of too many feed and fertilizer plants and greatly overlapping trade territories is costly. As long as farmers respond to differentiated competition, sizable possible savings will remain unrealized.

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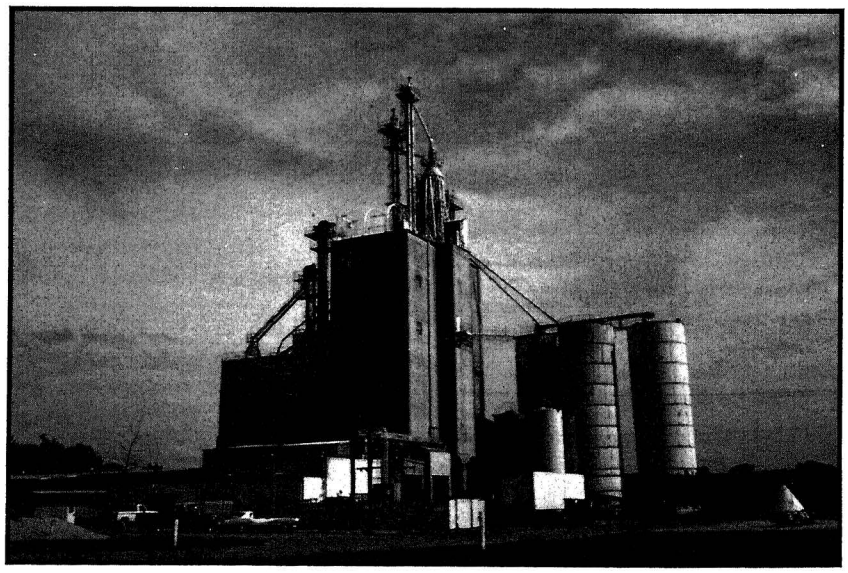
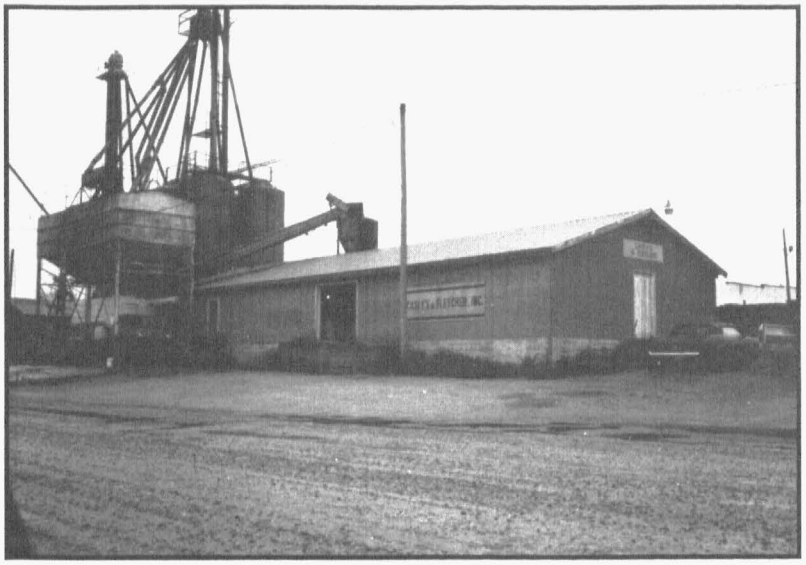
MFA, Inc., Springfield

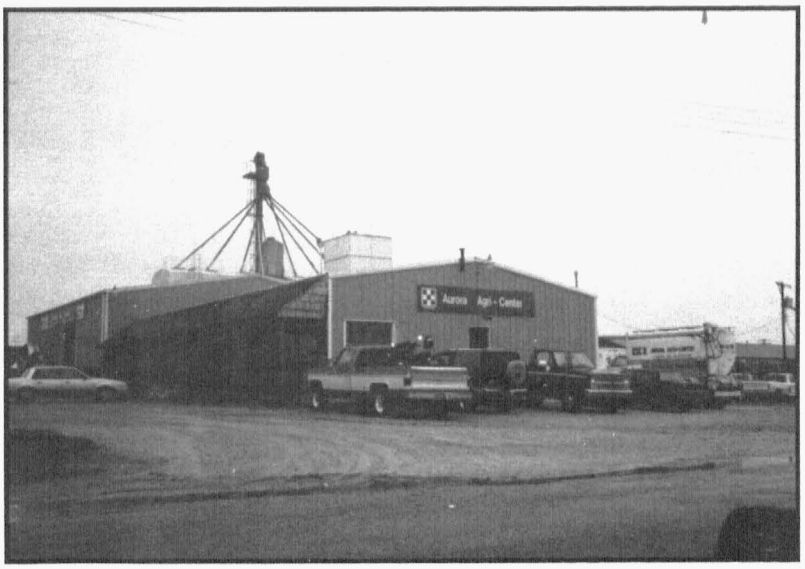
Purina Mills, Springfield





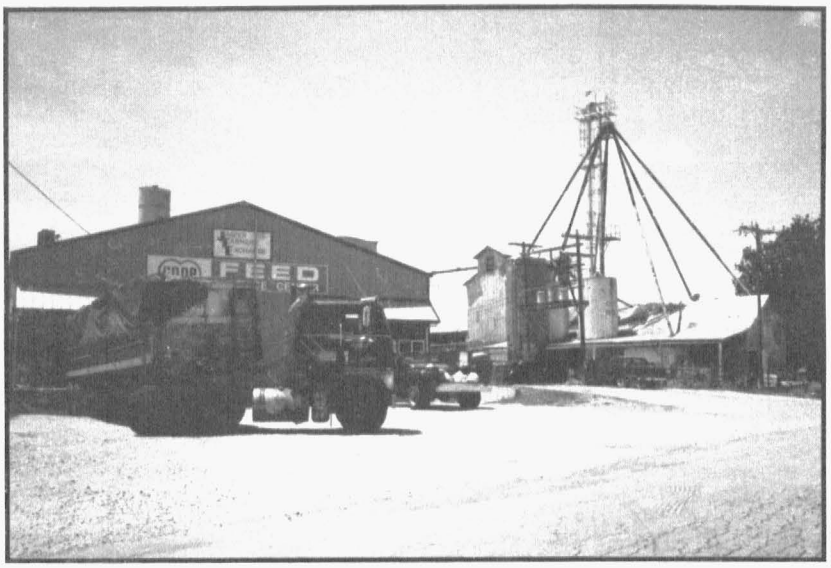
Caseys & Fletcher, Inc., Aurora

MFA Cooperative, Locally Owned,

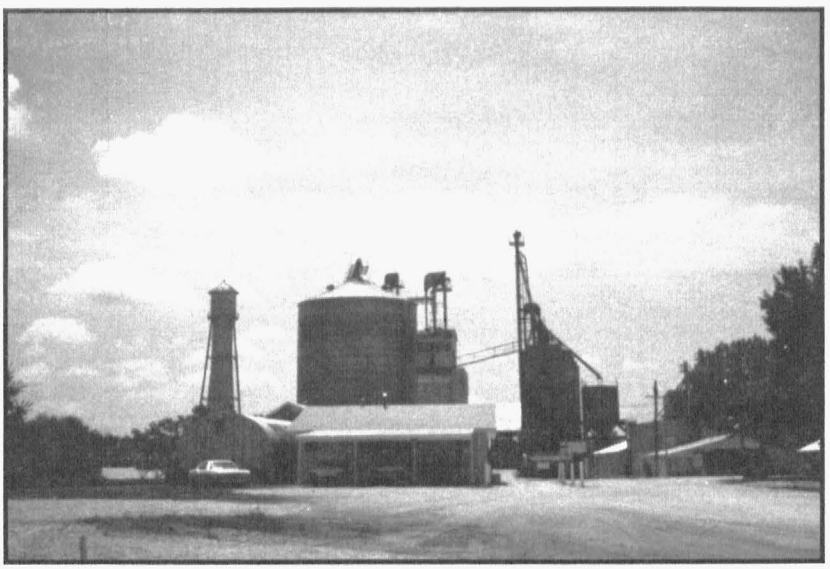


Aurora Agri-Center

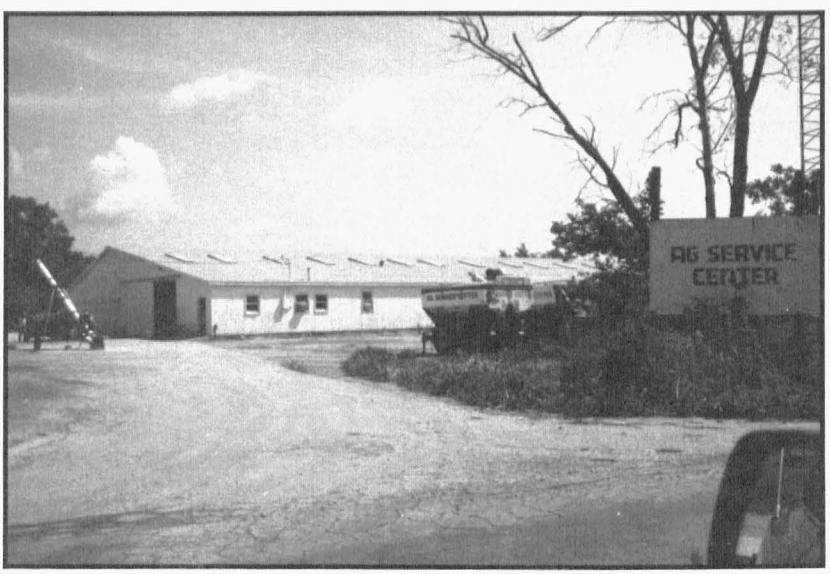
Jasper Farmers Exchange



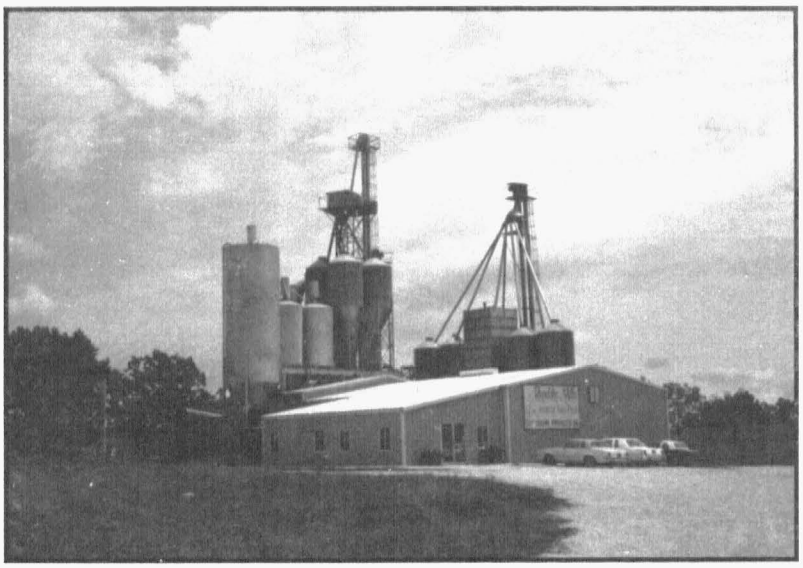
Maneval, Inc., Jasper



Ag Service Center, Lockwood



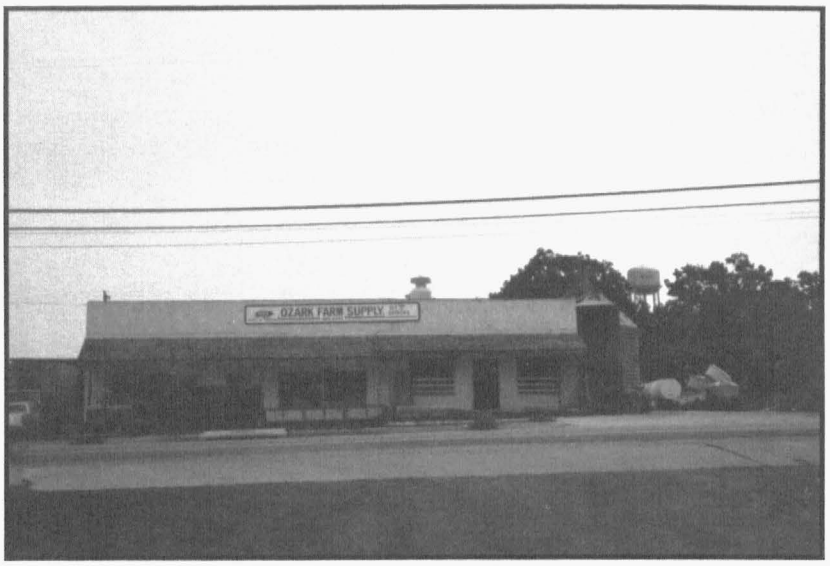
Billings Farmer Co-op



Republic Mills

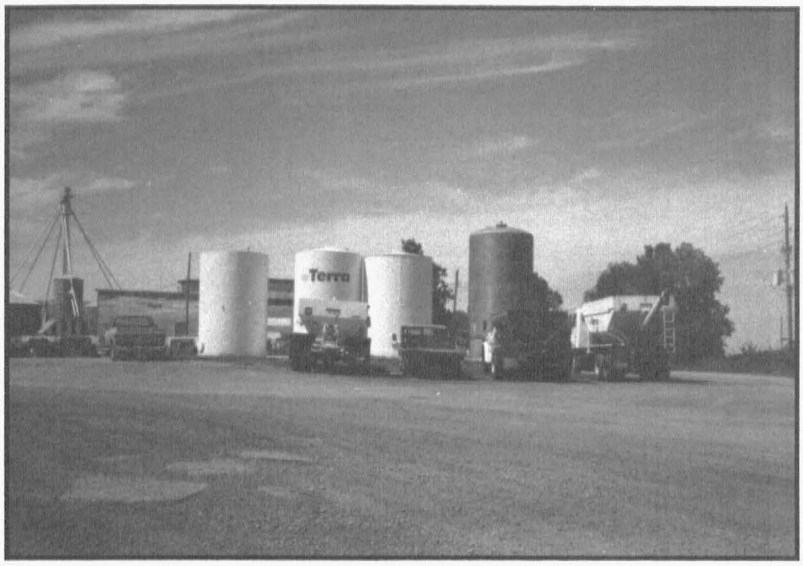
Willards Feed & Fertilizer, Inc.

Ozark Farm Supply



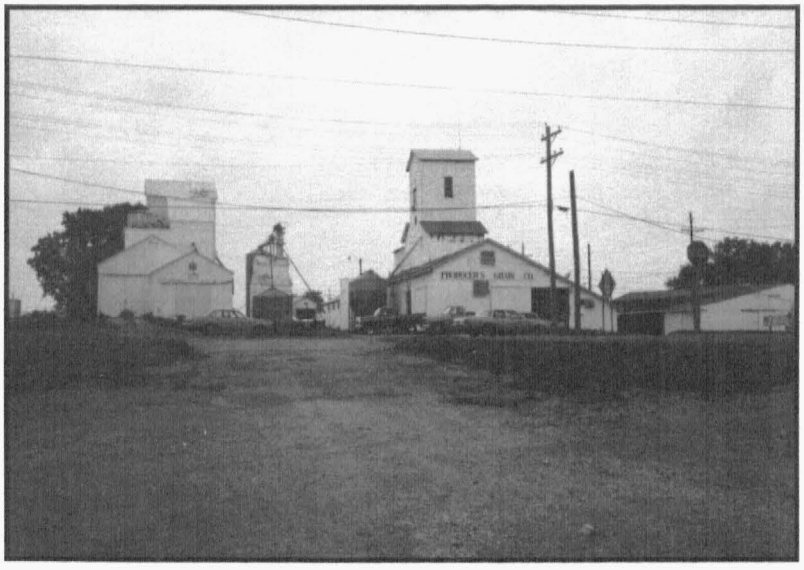
Christian County Farm Co-op, Ozark

D & D Feed & Farm Supply, Inc. Nixa



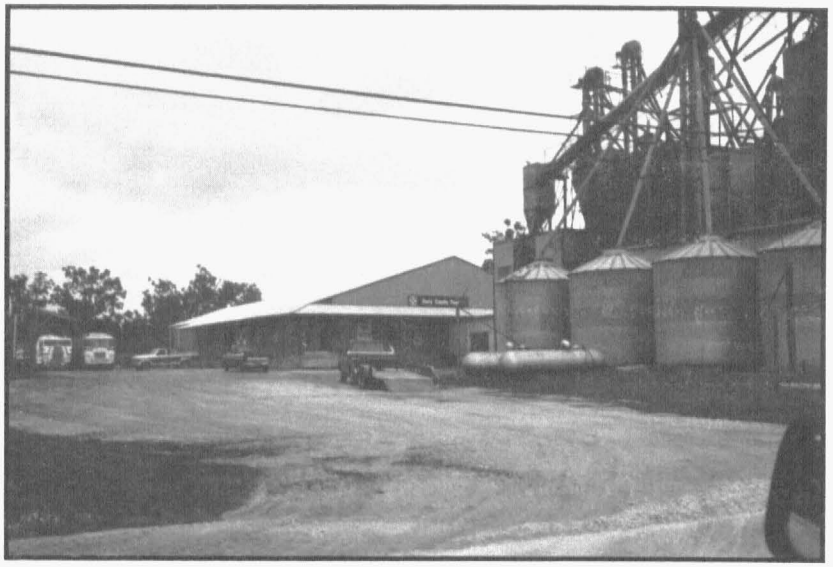
Terra International, Inc., Nevada

MFA, Inc., Fertilizer, El Dorado Springs



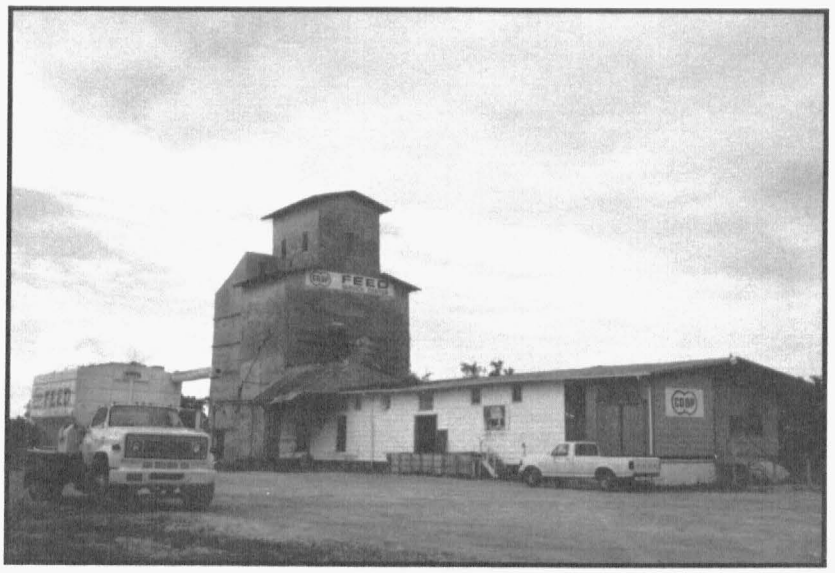
Producers Grain Co., El Dorado Springs

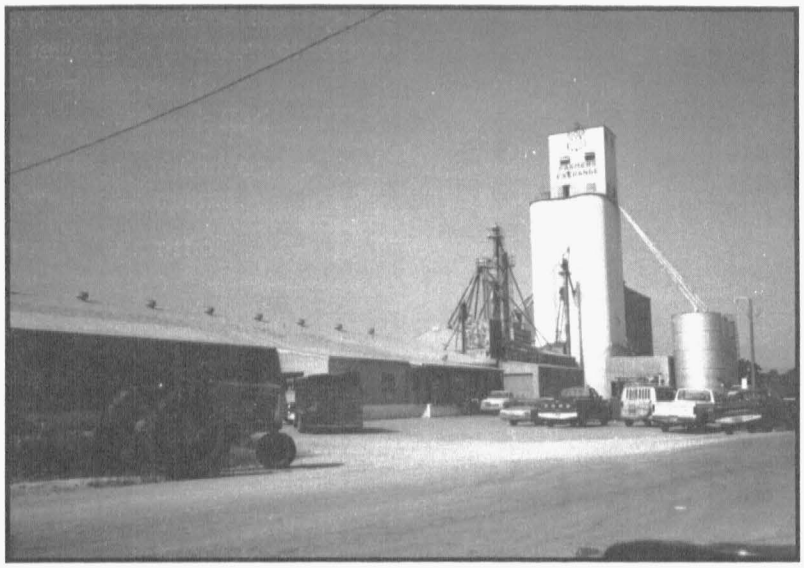
Barry County Feed, Wheaton



MFA, Inc., Retail Outlet, Cassville

Barry County Farmers Exchange, Stark City Branch



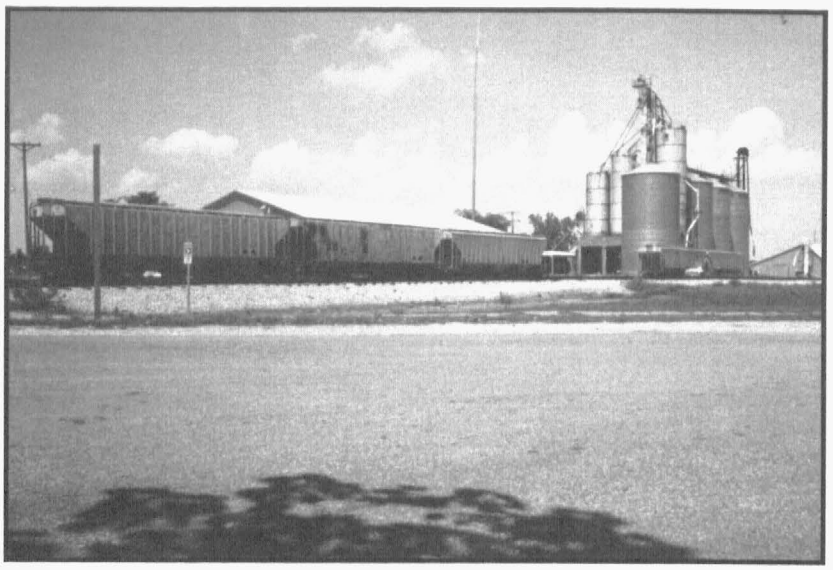


Lockwood Farmers Exchange

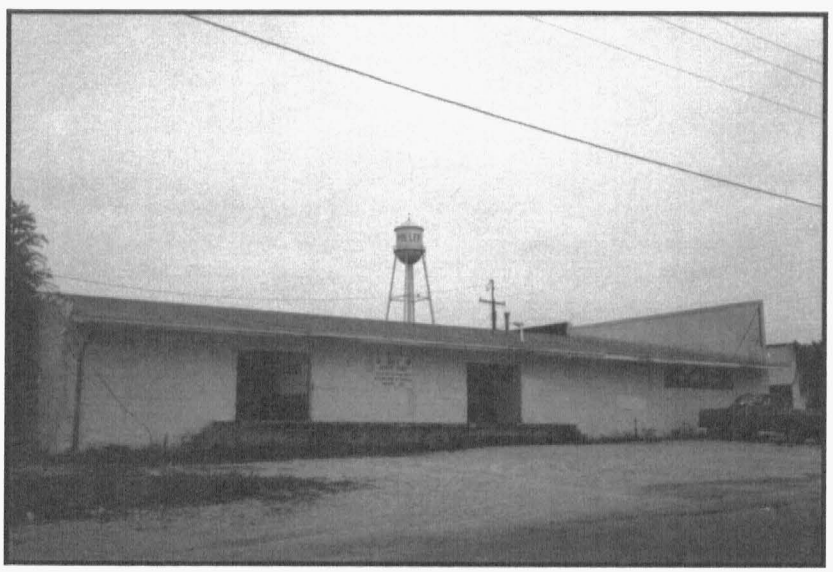
Mt.Vernon Farm Center

MFA, Inc., Fertilizer, Mt. Vernon

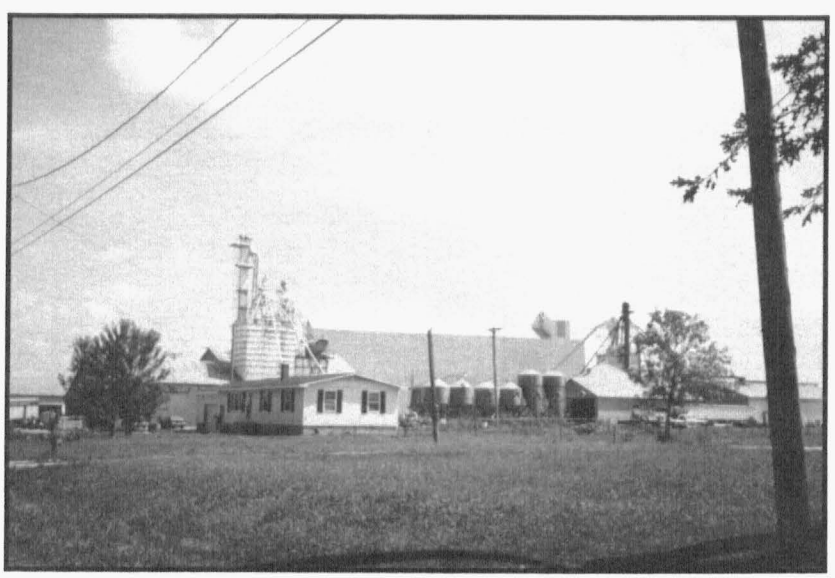
Producers Grain Co., Walker Branch



Miller Feed Store



Rice's, Golden City



Appendices

Appendix A

Sales of livestock and poultry in a 14 county area of Missouri, 1982.

County	Poultry	Livestock Dairy	Cattle	Hogs & Poultry	Total
		(Thousands of dollars)			
Barry	11,504	10,965	13,763	2,100	38,332
Barton	2,025	2,450	7,083	3,058	14,616
Cedar	24	1,690	6,186	2,395	10,295
Christian	d*	10,529	11,210	1,051	22,790
Dade	25	2,293	10,117	2,844	15,279
Dallas	3,669	12,342	8,647	1,444	26,102
Greene	1,220	14,623	16,490	1,034	33,367
Jasper	7,021	5,621	9,339	1,599	23,580
Lawrence	10,218	16,733	16,331	2,093	45,375
McDonald	31,094	3,750	9,352	3,859	48,055
Newton	21,062	7,606	9,498	1,061	39,227
Polk	2,588	15,992	15,485	2,393	36,458
Stone	d*	9,460	5,900	542	15,902
Vernon	20	2,498	9,753	4,621	16,892
Totals	90,470	116,552	149,154	30,094	386,270

Source (5). d = not identified at the county level to protect confidentiality.

Appendix B

Once feedmills are built, fully using that capacity is quite important in minimizing the unit costs of feed production and/or milling. Since volumes of feed are reported only periodically in the *Census of Agriculture*, this is an effort to estimate the quantity of feed as a first step in estimating the volume of feed consumption and thus, feed mill capacity usage.

Clearly, the highest volume feed is dairy. While specific tonnages are unavailable, estimates can be derived from milk marketing data. Changes in number of dairy farms, total milk sold, and average milk sold per farm are available through 1987 from the *Missouri Federal Order Milk Marketings*. Milk sold through this Order comprises an estimated 80 percent of total milk produced in the region (10).

The number of dairy farms included in the Missouri Federal Order Milk Marketings (MFOMM) in the 14-county study area declined from 1,144 in 1984 to 1,044 in 1988, or about 9 percent (Appendix B, Table 1). This represents about 80 percent of the milk marketed from that area. However, both total and average milk volume per farm increased substantially. Average milk produced per farm increased from 653,000 pounds to 832,000 pounds, or 27 percent during the five-year period. Several factors are important to note. First, feed prices were relatively low during the first part of 1987, thus, farmers fed more, resulting in higher production. Secondly, farmers remaining after the dairy buyout have increased herd size and kept their more productive cows. Together, both factors tend to increase the average quantity of milk produced per farm.

Total dairy inventory in the 14 counties serving the Federal Order Milk Marketing area, January 1, 1988 is 73,200 cows, an increase of about 3 percent over 1987 (3). Milk production also is up in 1988, and while year-end totals are unavailable, the MFOMM indicates that the increase will be about 3 percent greater than last year for the state, which basically reflects the increased inventory numbers. Changes that have occurred in the dairy industry during the past year include: 1) increased inventory numbers; 2) sharply higher feed prices; 3) decreased number of dairy farms; 4) gradual increase in milk production per cow. The influence that each of these factors had on milk production is not known.

Approximate dairy feed consumption can be estimated based on feed to milk conversion factors. Missouri feed to milk conversion efficiencies during 1986 and 1987 range from a low of 0.88 pounds of milk per pound of feed consumed to a high of 1.61, based on data from the Mail-In Farm Record Program (11, Appendix A, Table 2). This also includes feed for replacement heifers. Thus, farmers feeding an unusually large number of heifers will have a relatively low ratio of milk production per unit of feed consumption.

Appendix B, Table 1: Dairy farms and milk marketings in a 14-county Federal Order Milk Marketings area of SWMO, 1984-88

Item	1984	1985	1986	1987	1988
Number of farms					
SWMO	1,144	1,119	1,090	1,035	1,044
State	3,538	3,445	3,313	3,166	3,278
Number of cows					
SWMO	84,500	75,400	79,000	73,200	75,500
State	254,000	225,000	235,000	219,000	224,000
Total milk marketed (million #)					
SWMO	746.7	778.5	842.0	844.0	868.4
State	2,176.5	2,268.9	2,400.0	2,400.0	2,471.0
Average milk marketed per farm (1,000 #)					
SWMO	652.7	695.8	772.4	815.5	831.8
State	615.2	658.6	719.5	758.0	753.8

Sources (3,10).

Appendix B, Table 2: Feed to milk conversion efficiencies for Missouri dairy producers, 1986-1987

Pounds of milk sold per cow	Pounds of milk sold per pound ofconcentrate feed	
Thousands	1986	1987
12-14	1.61	1.28
14-16	1.39	0.88
over 16	1.36	1.50

Source (11).

Appendix C, Table 1: Estimates of manure and nutrient production for poultry

	Volume per 100 birds/year			
	Total solids	N	P	K
Type of poultry	Tons	#/year		
	dry weight basis			
Laying hens	1.16	69.4	41.0	53.1
Broilers	0.78	57.3	22.5	74.1
Turkeys	3.06	222.7	85.8	132.7

Source (12).

With the background information on dairy feed, an estimate of total feed consumption for the 14-county area of SWMO follows:

- 844 million pounds of milk produced in the Missouri Federal Milk Marketing District (14 county area of SWMO, 1987),
- 422,000 tons of milk = 80 percent of milk produced in area,
- 422,000/0.80 = 527,500 tons total milk production,
- Assume 1.34 pounds of milk per pound of feed consumed,
- 527,500 / 1.34 = 393,660 tons dairy feed,
- Dairy feed = 62 percent of total feed,
- 393,660 / 0.62 = 634,930 tons total feed for all livestock sold in area in 1987.

Appendix C

The nutrient content of poultry manure and litter depends on a number of factors, including the type of management system used. For broilers and turkeys, producers normally use litter in a confinement operation. Estimates of total residue (manure and litter) produced per 100 laying hens, broilers and turkeys capacity annually are 1.16, 0.78 and 3.06 tons, respectively (Appendix C, Table 1) (12). Estimates of nitrogen (N), phosphorous (P), and potassium (K) are included in Table 1. These data are on a dry weight basis and assume both manure and litter.

As indicated previously, the volume of poultry production in the area is unknown. However, general guidelines for establishing the most economical size integrated broiler unit include (13):

- one processing plant,
- about 400 houses to serve that plant,
- capacity of each house (40 ft x 400 ft) is 20,000 to 22,000 birds, depending on season and weather,
- an average of 6.5 flocks to be grown in each house annually (slightly less than 7 weeks per flock, depending on desired end weight),
- all 400 houses to be located within a 25-mile radius of the processing plant.

A measure of potential manure concentration can be identified by relating the quantity of manure by broilers (25-mile radius around the processing plant) relative to acres of cropland harvested which provides a measure of manure concentration. Using 1982 *Census of Agriculture*

data, harvested cropland was 15 percent of total land area for five counties in extreme SWMO. Based upon the above assumptions, the average residue application on cropland can be estimated as follows:

- a 25-mile radius includes 1,256,000 acres,
- 15 percent of that equals 188,400 acres of harvested cropland,
- residue production per broiler house = 156 tons per year,
- 400 houses = 62,480 tons per year (dry matter basis),
- thus, one-third ton of manure (dry basis) is available per acre of all cropland harvested in the area,
- N, P, and K availability from the residue are about 24, 10, and 31, pounds per acre, respectively.

The above numbers assume that all harvested cropland is available for spreading residue. Furthermore, they assume that only the houses for one integrator would be located in that 25-mile radius. Actually, considerable overlap exists among producing units of various integrators. Thus, it seems reasonable that increasing poultry production will have a significant adverse impact on commercial fertilizer sales.

Currently, seven integrators have production facilities in the five counties of extreme Southwest Missouri (Tysons, Hudsons, Simmons, Georges, ConAgra, Andersons, and Peterson Farms). Tysons has hog production units in SWMO and northern Arkansas. Egg production also occurs in the area. Considerable overlap exists among the production areas of the integrating firms.

Farmland Cooperative, Company Owned, Sheldon Missouri Branch of Lamar Co-op.