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# Fertilizer Operations of Local Farm Supply and Marketing Cooperatives

## Abstract

This report analyzes the fertilizer operations of 497 local farm supply and marketing cooperatives. They were surveyed about their 1996 fertilizer sales, source of product, competitors and type of competition, and services offered or desired to offer. Four questions focused on the relatively new use of global positioning and geographic information systems in fertilizer use and application. Fertilizer sales trends for these cooperatives during the past 11 years were compared to questionnaire responses, sales growth, and a prior survey. The data was also divided into 10 standard U.S. farm production regions and four cooperative sizes and types.

Key **words:** Cooperatives, fertilizer sales, precision agriculture, GPS/GIS technology, services, and farm supply sales.

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# Preface

This report studied the 1996 fertilizer sales and services of 497 local farmer cooperatives and compared them with fertilizer sales trends during the past 11 years. Changes in operations were also compared with a previous agronomy study that looked at services offered in 1985. Regional differences, as well as cooperative size and type differences, were a focus in this study. This information provides cooperative managers and boards of directors with a basis with which to compare their cooperatives' historical fertilizer sales performance and services offered with representative cooperative data. The author thanks the cooperatives that participated in this study.

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## Highlights

Almost 500 local farm supply and marketing cooperatives provided information about their fertilizer sales, sources, competition, type of competition, services, and types of payment for services. These locals represented 19 percent of all locals that sold fertilizer. In 1996, fertilizer sales of those surveyed were $1 .1 billion or 34 percent of all locals' fertilizer sales. The information gathered was combined with fertilizer sales data from the last 11 years, with comparisons by region, growth in sales, services offered, and comparisons to a 1985 agronomy study that asked similar questions.

The survey went to local cooperatives with fertilizer sales in excess of $0.5 million. Most were larger cooperatives, whose fertilizer sales averaged $2.2 million; farm supply sales, $8.6 million; and marketing sales, $9.9 million in 1996. Fertilizer sales growth was fairly steady, increasing a little more than 10 percent per year from 1985 to 1996. An analysis of local cooperative fertilizer operations showed:

. Liquid fertilizer comprised 19 percent of all fertilizer sales; anhydrous ammonia, 27 percent; and dry, mixtures, and lime, 54 percent.

. Most locals got their fertilizers from regional cooperatives. More than 88 percent of anhydrous ammonia, and dry, mixtures, and lime and almost 83 percent of the liquid fertilizer were received from regionals.

- The primary competitors were private fertilizer suppliers. Other cooperatives were a close second. Most often, price was the major competitive factor.

- More than 90 percent of the cooperatives provided fertilizer application, 88 percent soil testing, 74 percent fertilizer specialists, and 62 percent fertilizer records. Services offered varied by cooperative size. Larger cooperatives offered services more often. Cooperatives in the Corn Belt and Lakes States more frequently offered services. Since 1985, some cooperatives have dropped services. Also, growth in fertilizer sales during the 11 -year study period did not have a large impact on the frequency of offering services.

- Cooperatives were embracing precision agriculture-global positioning system (GPS) and global information system (GIS)—in applying fertilizer only where needed. Thirty-one percent offered field mapping using this technology. It was also used for computerized record keeping by cooperatives with 26 percent of the fertilizer volume; 24 percent of the cooperatives with application equipment; and 14 percent of the cooperatives that sold, rented, or leased GPS units to patrons.

# Fertilizer Operations of Local Farm Supply and Marketing Cooperatives

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Local agricultural cooperatives sold $3.2 billion, or 29 percent of the $10.9 billion farmers spent for farm production supplies-fertilizer, lime, and soil conditioners-in 1996. Fertilizer accounted for more than 6 percent of total farm production costs.

Increased input costs and environmental concerns coupled with low crop prices in the 1980s placed more emphasis on sustainable agriculture, using less fertilizer and crop protectants. In the 1990s precision agriculture became popular. Fertilizers were applied based on soil fertility and crop needs in 2.5- to 5-acre grids mapped with global positioning system (GPS) and geographic information system (GIS) technology.

Despite having a field map using this technology that shows prior crop yields and soil fertility based on soil tests, farmers are still left with many interpretation problems. Farmer-owned cooperatives, recognizing the need for better input information and analysis, have been on the forefront in providing fertilizer application with GPS, field mapping with GPS/GIS, computer record keeping with GPS/GIS, and fertilizer recommendations based on this technology.

With this in mind, local cooperatives that sold more than $0.5 million worth of fertilizers were asked about their fertilizer sales, sources, competition, type of competition, services, and how the cost of services was recovered. Questions focused on the relatively new use of GPS/GIS in fertilizer use and application. This study analyzes information from 497 local cooperatives. They represented 19 percent of locals selling fertilizer with $1.1 billion in sales (34 percent of total local cooperative fertilizer sales). The information gathered was combined with fertilizer sales information from the past 11 years and compared with a 1985 agronomy study, by region, growth in sales, and services offered. The presentation was subdivided into four cooperative sizes and types used in prior local agricultural cooperative studies [Eversull and Rotan].

## All Respondents

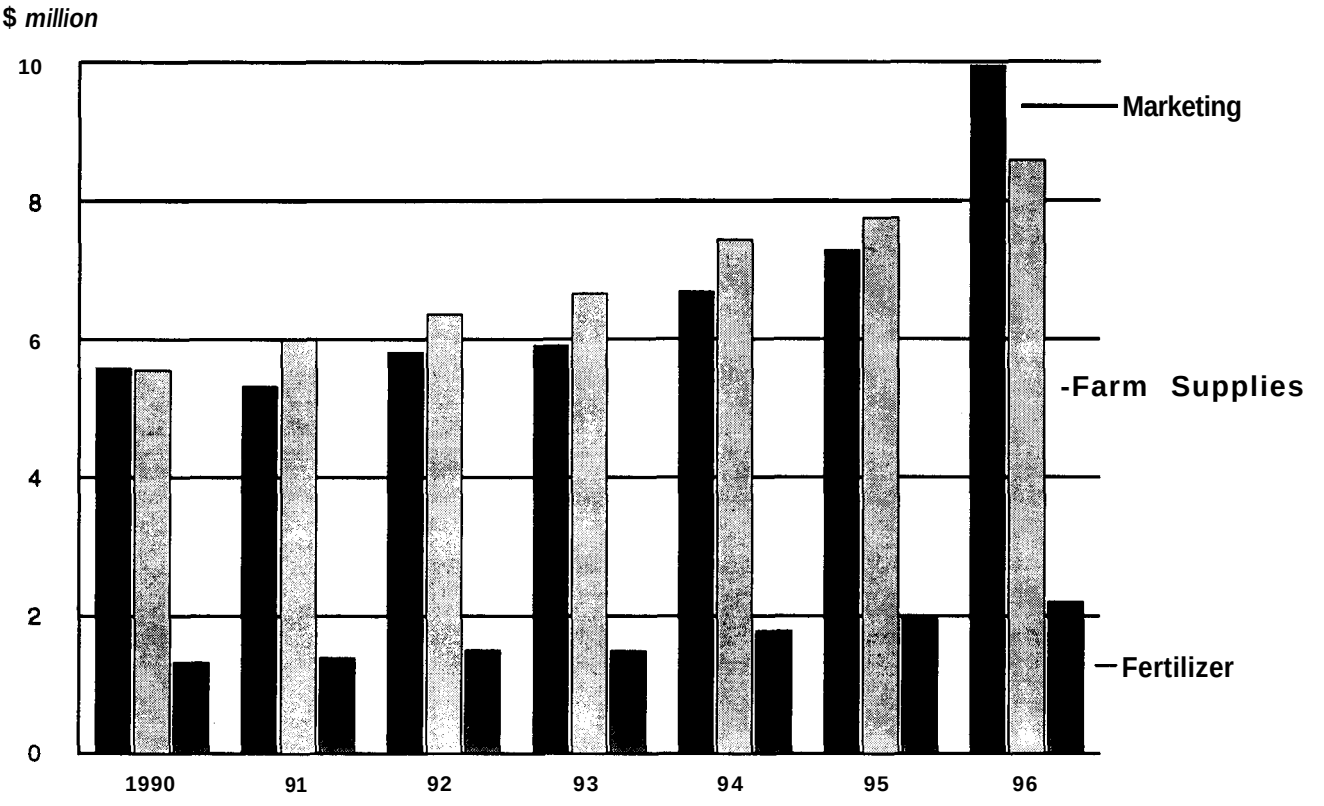
Staff of USDA's Rural Business-Cooperative Service (RBS) annually survey farmer cooperatives. Data from this survey and the RBS data base are used in this study.

Only local cooperatives with fertilizer sales in excess of $0.5 million were surveyed. Most were larger cooperatives with fertilizer sales averaging $2.2 million, farm supply sales $8.6 million, and marketing sales $9.9 million in 1996 (figure 1). Fertilizer sales increased steadily at a rate of a little more than 10 percent per year from 1985 to 1996.

Liquid fertilizer comprised 19 percent of all fertilizer sales, anhydrous ammonia, 27 percent; and dry, mixtures, and lime, 54 percent. Liquid fertilizer was sold by 384 respondents; anhydrous ammonia, 390; and dry, mixtures, and lime, 488. Most locals got their fertilizers from regionals-more than 88 percent of anhydrous ammonia, and dry, mixtures, and lime, and almost 83 percent of the liquid fertilizer (table 1). Private manufacturers provided 8 percent of this product.

With median fertilizer sales of $1.5 million that are much smaller than average sales of $2.2 million, more than one-half of the respondents are smaller than average. Some variation in responses between larger and smaller cooperatives might be expected. For example, the highest average competitor was another cooperative. Price was the major competitive factor (table 2). However, by weighting the responses by sales, larger cooperatives' responses were more favored. The primary competitor changes to private suppliers, at 41 percent (weighted by sales is fertilizer sales times survey response, so $0.5 million (fertilizer

Figure 1— **Respondent Sales**




sales) x 1 (survey response) = .5 million while a larger cooperative with $1 million in sales would be 1 million x 1 = 1 million).

Combining categories is another way of looking at the information presented in table 2. If the values for the competition from manufacturers, dealers, and private suppliers are combined, they are always the greatest competition, not another cooperative. The same is true for the type of competition. Combining service and availability with quality service and quality product resulted in competition that was greater than price for all categories except the average number one (53 versus 48 percent) and average number three (45 versus 41 percent) competitor.

Services offered and how the cost of providing those services was recovered is also analyzed. Eleven services were given. The first three covered equipment that the farmer would use to apply fertilizer. Dry fertilizer applicators (sometimes called buggies) were most often offered by the cooperatives, 88 percent (table 3). Usually the use of these applicators was paid for by an additional service charge-76 percent of the time by cooperatives in the survey.

For farmers applying anhydrous ammonia, nurse tanks (supply tanks) were offered by 80 percent of the cooperatives. Sixty-two percent of the time the cost of the supply tanks was included in the product price. Anhydrous ammonia tool bars were offered by 73

Table I- **Sources of fertilizer, weighted by sales**

| Fertilizer | Regional cooperative | Other cooperative | Private manufacturer | Private supplier | Other |
|---|---|---|---|---|---|
| | | | *Percent* | | |
| Anhydrous ammonia | 92.00 | 0.93 | 3.96 | 3.05 | 0.06 |
| Dry, mixtures, lime | 88.87 | 2.53 | 4.70 | 3.72 | .18 |
| Liquid | 82.83 | 2.96 | 7.73 | 6.45 | .03 |

percent of the cooperatives. Most recovered the cost with a service charge.

The next set of services dealt with cooperative personnel and equipment being used to provide them such as fertilizer application, soil testing, fertilizer specialists, and computerized fertilizer record keeping (table 4). Ninety-one percent of the cooperatives applied the fertilizer. More than 92 percent recovered application costs with an additional fee. Soil testing was offered by 88 percent of the cooperatives with 40 percent of them including the cost in the price and 60 percent charging an additional fee. Fertilizer specialists were used by 74 percent, with about 66 percent including the cost in the price of fertilizer. Computerized record keeping of fertilizer usage and performance was provided by 62 percent; another 14 percent hope to add this service in the future.

Precision agriculture's emerging use of GPS/GIS in fertilizer sales and application was the final service analyzed including whether the cooperative sold,

**Table 2— Top three competitors and type of competition, average and weighted by sales**

| Competitor | Manufacturer | Dealer | Private supplier | Other cooperative | Type of competition: Price | Type of competition: Service and availability | Type of competition: Quality service and product |
|---|---|---|---|---|---|---|---|
| | | | | *Percent* | | | |
| Number One | | | | | | | |
| Average | 13.08 | 6.84 | 37.83 | 42.25 | 52.50 | 24.05 | 23.45 |
| Weighted | 14.09 | 6.48 | 40.66 | 38.77 | 47.62 | 26.16 | 26.22 |
| Number Two | | | | | | | |
| Average [1] | 7.65 | 7.24 | 37.42 | 42.66 | 45.67 | 26.81 | 22.49 |
| Weighted [1] | 12.84 | 5.24 | 38.32 | 40.26 | 42.90 | 28.24 | 25.52 |
| Number Three | | | | | | | |
| Average [1] | 8.85 | 11.67 | 29.78 | 35.61 | 44.83 | 20.69 | 20.39 |
| Weighted [1] | 9.29 | 14.47 | 33.12 | 32.25 | 44.39 | 21.29 | 23.47 |

[1] Values for competitors two and three do not add to 100 as not all cooperatives had more than one competitor.

**Table 3— Equipment offered to farmers for fertilizer application and how their cost is recovered**

| Equipment | Currently offer | Would like to offer | Cost recovery method: Include cost in product price | Cost recovery method: Additional service charge |
|---|---|---|---|---|
| | | *Percent* | | |
| Dry fertilizer applicators | 87.75 | 0.78 | 23.81 | 76.19 |
| Anhydrous ammonia nurse tanks | 79.61 | .89 | 62.02 | 37.98 |
| Anhydrous ammonia tool bars | 73.10 | .76 | 25.82 | 74.18 |

**Table 4— Fertilizer services provided with cooperative personnel and equipment and how their cost is recovered, weighted by sales**

| Service | Currently offer | Would like to offer | Cost recovery method: Include cost in product price | Cost recovery method: Additional service charge |
|---|---|---|---|---|
| | | *Percent* | | |
| Application | 90.57 | 0.83 | 7.94 | 92.06 |
| Soil testing | 87.99 | 1.26 | 39.72 | 60.28 |
| Specialists | 74.39 | 8.20 | 66.38 | 33.62 |
| Computer records | 61.97 | 14.11 | 77.69 | 22.31 |

rented, or leased GPS units, had application equipment using this technology, mapped fields with GPS/GIS, provided computer records and recommendations using GPS/GIS, or would like to.

If the "currently offered" and "would like to offer" categories are combined, between 42 and 55 percent of the cooperatives were interested in the GPS/GIS technology (table 5). There is more use or interest in this technology if the responses are weighted by sales. Obviously, the larger cooperatives were more able to adopt this technology as the weighted responses show. But, the cost of providing these services may be prohibitive to small cooperatives, which would also lower the average values.

The most often offered service using this new technology is field mapping, with an average 21 percent usage and a weighted average 50 percent higher at 31 percent. When "currently offer" was combined with "like to offer," these figures increase to 55 and 63 percent, respectively. As with all GPS/GIS services, most cooperatives recovered the cost by an additional service charge.

Computer record keeping using GPS/GIS was the second most often offered service in this area. Because the records were entered into the computer for field mapping (the most offered service), computer record keeping was a closely related service. Again, the weighted "currently offer" response at 26 percent was about 50 percent higher than the average (16 percent). Between 52 and 60 percent of the cooperatives do, or would like to offer computer record keeping with GPS/GIS.

Cooperatives have application equipment using GPS about 15 percent of the time. The weighted average, 24 percent, is much higher and would be expected as application equipment with GPS can be very expensive. Several cooperatives expressed interest in application equipment, but cited high investment costs and doubted they had large enough volumes to support these costs.

These cooperatives indicated that adding this technology to existing equipment would cost $25,000 for the unit-to-control-one box (or single fertilizer type) on the applicator. The cost increases exponentially to $200,000 to modify the equipment to apply two fertilizers in one pass with a GPS unit. And, if the cooperative wants to apply diammonium phosphate, urea, potash, and impregnate liquid fertilizer in one pass, the GPS unit capable of handling this will cost $300,000 on existing equipment.

Larger cooperatives that are more able to spend this amount for application equipment will be more likely to be the early adopters of precision agriculture. More widespread usage and higher sales of GPS units will probably cut costs, as is the case for most new technology.

The final service from table 5 was selling, renting, or leasing GPS units to farmers. With a number of competing firms providing GPS units and the systems being a little different, the farmer is faced with a $3,000 to $10,000 investment that may be technologically outmoded in a few years. For this reason, some cooperatives are providing GPS systems for their patrons.

Renting or leasing to patrons gets the units quickly to innovative farmers and lets them decide if

Table 5— GPS and GIS services and equipment provided and how the cost is recovered

| | | Cost recovery method | | |
|---|---|---|---|---|
| | | *Percent* | | |
| **Sell, rent, or lease GPS units** | | | | |
| | 9.05 | 33.80 | 15.56 | *84.44* |
| | 14.44 | 31.91 | 14.50 | *87.15* |
| | 14.89 | 35.61 | 10.81 | 89.19 |
| | 23.83 | 34.06 | 12.85 | 87.15 |
| **GPS/GIS** | | | | |
| | 20.93 | 34.21 | 10.10 | **89.90** |
| | 31.36 | 31.96 | 14.39 | 85.61 |
| **GPS/GIS** | | | | |
| | 16.30 | 35.61 | 25.31 | 74.69 |
| | 25.54 | 34.32 | 25.93 | 74.07 |

they want to convert both their planting and harvesting machines to GPS technology. The cooperative will provide field mapping, computer record keeping, and fertilizer application services as more farmers acquire the units and will be able to integrate information from the farmer's and cooperative's GPS units. With this in mind, slightly more than 9 percent of the cooperatives sell, rent, or lease GPS units. The weighted average was about 50 percent higher (14 percent).

### Quartile Rankings Based on Sales Growth

This section ranks the respondents by using fertilizer sales growth from 1985 through 1996. The top 100 cooperatives in fertilizer sales growth are called quartile 1, the second 100 are quartile 2, etc. Twenty-nine cooperatives did not have overall growth in fertilizer sales. The average growth per year was a little more than 10 percent. This means growth exceeded price increases brought on by inflation. Average growth for quartile 1 cooperatives was 24 percent per year (table 6). Twenty-four percent growth would mean sales doubled every 4 years.

On closer inspection, many of these cooperatives with large increases in fertilizer sales grew through mergers, consolidations, and acquisitions. This type of growth was evident for 19 cooperatives in quartile 1, 15 in quartile 2, 10 in quartile 3, 12 in quartile 4, and 4 in quartile 5 for 1992 through 1996 (prior years not readily available).

Types of fertilizers sold does not appear to influence growth. On average, all cooperatives had sales of 20 percent to 27 percent for anhydrous ammonia; 53 percent to 60 percent dry, mixtures, or lime; and 18 percent to 21 percent liquid fertilizers. Growth was heavily influenced by volume; quartile 1 cooperatives had fertilizer sales averaging $2.6 million, while sales fell to $1.7 million for quartile 5 cooperatives.

Quartile rankings were developed to compare and contrast cooperatives that had large increases in fertilizer sales with ones that had low or little growth. It was hoped some trend or theme might be established in this section that would contrast quartile 1 cooperative fertilizer operations with those of quartile 5. Instead, few differences were found in their sources of fertilizer (appendix table 1), their top three competitors and types of competition (appendix table 2), equipment offered and how cost is recovered (appendix table 3), and finally, services provided with cooperative personnel and equipment and how cost is recovered (appendix table 4).

One distinction emerged. Quartile 4 and 5 cooperatives had manufacturers as number one competitors much more often than the other cooperatives. The weighted average for a manufacturer as a number one competitor (table 2) was 14 percent while quartile 4 reported 18 percent and quartile 5 was almost double at 27 percent. Quartile 5 cooperatives also had more private suppliers as number one competitors and far fewer cooperative competitors (20 percent versus 39 weighted average).

It was felt that the lower growth quartile 5 cooperatives would be especially low adopters of precision agriculture. Knowing that their fertilizer sales growth were the lowest and that larger cooperatives were more able to afford the GPS/GIS technology further reinforces this premise. But, as shown in table 7, quartile 5 cooperatives surprisingly were leaders in offering this technology.

If responses are not weighted by sales, all GPS/GIS services and equipment offered have a lower value than the average reported in table 5. So, there must be a few large cooperatives in this group pushing up the technology values. This is borne out by the fact that median fertilizer sales were $1.1 million while the average was $1.7 million. When focusing on the 42 percent of quartile 5 cooperatives that provide field mapping with GPS/GIS, it was found that their average fertilizer sales were $4.1 million while their sales growth was less than 1 percent per year. The other contrast in table 7 is that the quartile 1 cooperatives more often (but still less than half the time in all

**Table 6—Types of fertilizer sold based on quartile growth rankings, weighted by sales**

| | | *Percent* | | *Dollars* |
|---|---|---|---|---|
| 27.15 | 52.69 | 20.16 | 23.96 | 2,646,422 |
| 25.35 | 55.53 | 19.12 | 12.49 | 2,166,105 |
| 19.62 | 59.51 | 20.86 | 8.32 | 1,996,560 |
| 23.24 | 58.74 | 18.03 | 5.05 | 1,881,660 |
| 23.52 | 57.11 | 19.38 | .93 | 1,677,025 |

instances) include the cost of this technology in the product's prices than the quartile 5 cooperatives.

## GPS/GIS Technology

As established earlier, cooperatives that have adopted precision agriculture tended to have larger fertilizer sales, but not necessarily those that have experienced large growth in these sales. This section focuses on the 104 cooperatives that offer field mapping, the most popular use of this GPS/GIS technology, and compares them with the average respondent.

The cooperatives that have adopted this technology were larger than the average respondent—fertilizer sales averaged $3.3 million compared with $2.2 million for all respondents. These cooperatives were more likely to purchase their fertilizers from a regional cooperative than the average (table 8). About 91 percent of all fertilizers were purchased from regional cooperatives-98 percent for anhydrous ammonia. The regional cooperatives-Farmland, GROWMARK, and CENEX/Land O'Lakes-were most likely supplying both fertilizers and precision agriculture technology to many of these local cooperatives.

The number one and two competitors were other cooperatives, while the average was most often a private supplier (table 9). Services were probably important to these cooperatives as they made fertilizer recommendations and interpreted the field maps based on the GPS/GIS technology. Another conclusion is that although they felt that price was their major competition, service was also important. These cooperatives generally rated their competition's service and availability and quality service and product higher than the average respondent.

GPS/GIS equipment for fertilizer application was generally offered more often by these cooperatives than the average (table 10). About 94 percent of the cooperatives offered dry fertilizer applicators and 97

**Table 7— GPS and GIS services and equipment provided by quartile ranking and how the cost is recovered, weighted by sales**

| Service | Currently offer | Would like to offer | Cost recovery method: Include cost in product price | Cost recovery method: Additional service charge |
|---|---|---|---|---|
| | | | *Percent* | |
| **Sell, rent, or lease GPS units** | | | | |
| Quartile 1 | 18.33 | 33.50 | 20.34 | 79.66 |
| Quartile 2 | 11.45 | 33.65 | 33.15 | 66.85 |
| Quartile 3 | 10.40 | 44.07 | — | 100.00 |
| Quartile 4 | 12.45 | 29.42 | 10.23 | 89.77 |
| Quartile 5 | 23.99 | 25.98 | 5.93 | 94.07 |
| **Application with GPS** | | | | |
| Quartile 1 | 20.31 | 46.27 | 45.72 | 54.28 |
| Quartile 2 | 21.60 | 31.30 | 6.58 | 93.42 |
| Quartile 3 | 21.52 | 45.34 | 4.50 | 95.20 |
| Quartile 4 | 29.33 | 28.70 | 6.99 | 93.01 |
| Quartile 5 | 36.68 | 22.14 | — | 100.00 |
| **Field mapping with GPS/GIS** | | | | |
| Quartile 1 | 31.06 | 41.62 | 29.99 | 70.01 |
| Quartile 2 | 32.83 | 30.60 | 11.29 | 88.71 |
| Quartile 3 | 27.03 | 44.88 | 14.92 | 85.08 |
| Quartile 4 | 34.46 | 23.85 | 1.78 | 98.22 |
| Quartile 5 | 41.92 | 22.75 | 10.51 | 89.49 |
| **Computer records with GPS/GIS** | | | | |
| Quartile 1 | 27.68 | 44.09 | 37.89 | 62.11 |
| Quartile 2 | 24.48 | 32.47 | 35.91 | 64.71 |
| Quartile 3 | 25.63 | 42.10 | 28.52 | 71.48 |
| Quartile 4 | 27.78 | 29.82 | 11.30 | 88.70 |
| Quartile 5 | 29.32 | 28.43 | 10.20 | 89.80 |

— = No responses.

Table s-Sources **of fertilizer for cooperatives using GPS/GIS field mapping compared to other respondents, weighted by sales**

| Fertilizer | Regional cooperative | Other cooperative | Private manufacturer | Private supplier | Other |
|---|---|---|---|---|---|
| | | | *Percent,* | | |
| **Anhydrous ammonia** | | | | | |
| GPS/GIS cooperatives | 97.52 | — | 0.81 | 1.67 | — |
| Weighted average | 92.00 | 0.93 | 3.96 | 3.05 | 0.06 |
| **Dry, mixtures, lime** | | | | | |
| GPS/GIS cooperatives | 94.54 | .87 | 2.09 | 2.29 | .21 |
| Weighted average | 88.87 | 2.53 | 4.70 | 3.72 | .18 |
| **Liquid** | | | | | |
| GPS/GIS cooperatives | 90.55 | 1.93 | 5.52 | 2.00 | — |
| Weighted average | 82.83 | 2.96 | 7.73 | 6.45 | .03 |

— = No responses.

Table s-Top **three competitors and type of competition for cooperatives using GPS/GIS field mapping compared to other respondents, weighted by sales**

| Competitor | Manufacturer | Dealer | Private supplier | Other cooperative | Type of competition: Price | Type of competition: Service and availability | Type of competition: Quality service and product |
|---|---|---|---|---|---|---|---|
| | | | | *Percent* | | | |
| **Number One** | | | | | | | |
| GPS/GIS cooperatives | 21.06 | 5.39 | 33.69 | 39.86 | 41.25 | 32.17 | 26.58 |
| Weighted average | 14.09 | 6.48 | 40.66 | 38.77 | 47.62 | 26.16 | 26.22 |
| **Number Two** [1] | | | | | | | |
| GPS/GIS cooperatives | 11.65 | .97 | 42.48 | 43.58 | 37.21 | 32.84 | 28.94 |
| Weighted average | 12.84 | 5.24 | 38.32 | 40.26 | 42.90 | 28.24 | 25.52 |
| Number Three [1] | | | | | | | |
| GPS/GIS cooperatives | 8.39 | 5.88 | 46.83 | 30.77 | 38.10 | 26.33 | 27.45 |
| Weighted average | 9.29 | 14.47 | 33.12 | 32.25 | 44.39 | 21.29 | 23.47 |

[1] Values for competitors two and three do not add to 100 as not all cooperatives had more than one competitor.

Table 10— **Equipment offered to farmers for fertilizer application and how their cost is recovered for cooperatives using GPS/GIS field mapping compared to other respondents, weighted by sales**

| Equipment | Currently offer | Would like to offer | Cost recovery method: Include cost in product price | Cost recovery method: Additional service charge |
|---|---|---|---|---|
| | | | *Percent* | |
| **Dry fertilizer applicators** | | | | |
| GPS/GIS cooperatives | 93.88 | 1.60 | 20.37 | 79.63 |
| Weighted average | 90.74 | .60 | 25.17 | 74.83 |
| Anhydrous ammonia nurse tanks | | | | |
| GPS/GIS cooperatives | 98.58 | — | 65.94 | 34.06 |
| Weighted average | 76.06 | 1.61 | 65.21 | 34.79 |
| Anhydrous ammonia tool bars | | | | |
| GPS/GIS cooperatives | 96.65 | .24 | 30.23 | 69.77 |
| Weighted average | 68.81 | 1.41 | 24.05 | 75.95 |

— = No responses.

percent had anhydrous ammonia tool bars or nurse tanks. Offering anhydrous equipment for farmer usage was especially more frequently done so by these cooperatives. Methods to recover cost were about the same as the average.

Cooperatives offering GPS/GIS field mapping would probably be focusing on fertilizer sales and service and offering a full line of services. In table 11, the GPS/GIS cooperatives more likely offered the four services listed. All cooperatives provided application services and 96 percent had soil testing. Ninety percent offered a fertilizer specialist to help interpret field maps. Computer record keeping was also more common (83 percent).

Cooperatives that have field mapping using GPS/GIS were also about three times more likely to offer the precision agriculture services listed in table 12. About 80 percent of these cooperatives kept

**Table 11- Fertilizer services provided with cooperative personnel and equipment and how their cost is recovered for cooperatives using GPS/GIS field mapping compared to other respondents, weighted by sales**

| Service | Currently offer | Would like to offer | Cost recovery method: Include cost in product price | Cost recovery method: Additional service charge |
|---|---|---|---|---|
| | | | *Percent* | |
| **Application** | | | | |
| GPS/GIS cooperatives | 100.00 | — | *5.72* | *94.28* |
| Weighted average | 91.35 | 2.01 | 9.97 | 90.03 |
| **Soil testing** | | | | |
| GPS/GIS cooperatives | 96.27 | .09 | 35.88 | 64.12 |
| Weighted average | 89.74 | 2.21 | 41.03 | 58.97 |
| **Specialists** | | | | |
| GPS/GIS cooperatives | 90.21 | 5.52 | 71.62 | 28.38 |
| Weighted average | 69.82 | 11.27 | 68.44 | 31.56 |
| **Computer records** | | | | |
| GPS/GIS cooperatives | 83.03 | 4.67 | 74.10 | 25.90 |
| Weighted average | 57.75 | 18.31 | 79.44 | 20.56 |

— = No responses.

**Table 12— GPS and GIS services and equipment provided and how the cost is recovered for cooperatives using GPS/GIS field mapping compared to other respondents, weighted by sales**

| Service | Currently offer | Would like to offer | Cost recovery method: Include cost in product price | Cost recovery method: Additional service charge |
|---|---|---|---|---|
| | | | Percent | |
| Sell, **rent, or lease GPS units** | | | | |
| GPS/GIS cooperatives | 41.64 | 17.24 | 12.12 | 87.88 |
| Weighted average | 14.44 | 31.91 | 14.50 | 87.15 |
| **Application with GPS** | | | | |
| GPS/GIS cooperatives | 72.19 | 16.13 | 13.53 | 86.47 |
| Weighted average | 23.83 | 34.06 | 12.85 | 87.15 |
| **Field mapping with GPS/GIS** | | | | |
| GPS/GIS cooperatives | 100.00 | — | 14.39 | 85.61 |
| Weighted average | 31.36 | 31.96 | 14.39 | 85.61 |
| **Computer records with GPS/GIS** | | | | |
| GPS/GIS cooperatives | 79.47 | 14.00 | 25.49 | 74.19 |
| Weighted average | 25.54 | 34.32 | 25.93 | 74.07 |

— = No responses.

computer records using GPS/GIS of patrons' fertilizer usage, slightly less than the 83 percent reported in table 11. Seventy-two percent of these cooperatives had application equipment using GPS, which was 28 percentage points lower than reported in table 11 where all the cooperatives had application equipment. About 42 percent of these cooperatives were trying to increase patron use of the technology by selling, renting, or leasing GPS units to farmers.

## Regional Comparisons

More so than any prior comparisons in this study, there were differences in cooperative fertilizer operations when the data is presented by regions. Ten standard farm production regions [1] were used. The number of cooperative respondents in each region were: Northeast (NE), 3; Lake States (LS), 110; Corn Belt (CB), 145; Northern Plains (NP), 119; Appalachian (AP), 32; Southeast (SE), 5; Delta States (DS), 11; Southern Plains (SP), 33; Mountain (MT), 28; and Pacific (PA), 11. For some of the regions, especially NE and SE with their small number of respondent cooperatives, it would be impossible to state that the sample population was representative of all cooperatives in that region. But, the information may still be useful to these cooperatives.

[1] Standard farm production regions used, Northeast: ME, NH, VT, NY, MA, RI, CT, PA, NJ, DE, MD, and DC. Lake States: MI, WI, and MN. Corn Belt: OH, IN, IL, IA, and MO. Northern Plains: ND, SD, NE, and KS. Appalachian: VA, WV, KY, TN, and NC. Southeast: SC, GA, AL, and FL. Delta States: MS, LA, and AR. Southern Plains: OK and TX. Mountain: MT, ID, WY, CO, UT, NV, AZ, and NM. Pacific: WA, OR, CA, HI, and AK.

Fertilizer sales averaged between $1.6 million and $2.3 million in most regions (table 13). The exceptions were the NE ($0.8 million) and CB ($2.6 million). Average growth in fertilizer sales was a little more than 10 percent, so three regions had above average growth and seven below average. Some of this growth can be attributed to mergers, consolidations, and acquisitions. From 1992 through 1996, there were 60 of these changes by respondent cooperatives. Their average growth was 13 percent for the study period. By region, there were 19 mergers, consolidations, or acquisitions in the CB; 17 in LS; 16 in NP; 4 in SP; 3 in NP; and 1 in PA.

In most instances, the source of the majority of respondent cooperative fertilizer was regional cooperatives (table 14). In AP and PA regions liquid fertilizers were most often purchased from private manufacturers or suppliers.

In half the regions, the number one and three competitors were cooperatives, and in the other half, private suppliers or dealers (table 15). The number two competitor was a private supplier in 7 of 10 regions. Price was the major source of competition in 7 regions for competitor number one and in 9 regions for numbers two and three. Service and availability and quality service and product still seemed important in fertilizer sales with competitor number two, especially if both of these types of competition were combined. For competitor number two, combining service and availability with quality service and product would be more important than price alone in 7 out of 10 regions.

Dry fertilizer applicators were offered by about 90 percent of the cooperatives in each region, with the exception being PA (60 percent, table 16). Most often the cost of these applicators was recovered by an addi-

**Table 13—Types of fertilizer sold by region, weighted by sales**

| Regions | Anhydrous ammonia | Dry, mixtures, lime | Liquid | Average growth | Average sales |
|---|---|---|---|---|---|
| | | | *Percent* | | *Dollars* |
| Northeast | — | 93.42 | 6.58 | 5.34 | 786,041 |
| Lake States | 18.10 | 68.78 | 13.13 | 10.34 | 2,012,622 |
| Corn Belt | 24.48 | 55.06 | 20.46 | 8.37 | 2,567,576 |
| Northern Plains | 38.21 | 35.51 | 26.28 | 13.94 | 1,933,908 |
| Appalachian | 5.36 | 89.95 | 4.68 | 6.31 | 1,769,045 |
| Southeast | 23.47 | 58.62 | 17.91 | 3.74 | 1,926,305 |
| Delta States | .77 | 95.45 | 3.78 | 5.62 | 1,608,187 |
| Southern Plains | 23.59 | 50.66 | 25.75 | 9.54 | 1,347,914 |
| Mountain | 17.71 | 56.06 | 26.22 | 13.42 | 2,272,125 |
| Pacific | 14.84 | 64.69 | 20.47 | 6.55 | 1,856,548 |

— = No responses.

tional charge. DS and SP included the cost in the product price. Anhydrous ammonia equipment was not provided in NE or SE. This equipment was also not provided very often in AP, DS, and PA. The cost of the nurse tanks was most often recovered in the product price, while the tools bars were paid for by an additional service charge.

Most cooperatives offered fertilizer application, soil testing, specialists, and computer records of fertilizer usage (table 17). Application was most often paid for with an additional service charge. Soil testing costs were recovered in the product price in half the regions and by an additional service charge in the others. The SE and SP had the smallest percentage of specialists, at 43 percent and 48 percent. Twenty-one percent of the cooperatives in the SP hope to add a specialist. Computer record keeping was also low in the DS (35 percent) although an additional 33 percent would like to offer the service.

In most regions, the use of precision agriculture by cooperatives was very low, although there was considerable interest in wanting to offer the services and equipment (table 18). However, in the LS and CB, more than 20 percent of all the services offered included GPS/GIS technology. Common denominators to the early adoption of the technology in these two regions are probably the high use of nitrogen fertilizers on corn, the predominance of corn grown, the cost of

**Table 14— Sources of fertilizer by region, weighted by sales**

| Fertilizer | Regional cooperative | Other cooperative | Private manufacturer | Private supplier | Other |
|---|---|---|---|---|---|
| | | | Percent | | |
| Anhydrous ammonia | | | | | |
| Northeast | — | — | — | — | — |
| Lake States | 93.77 | 0.97 | 4.42 | 0.83 | — |
| Corn Belt | 97.62 | .04 | .47 | 1.86 | — |
| Northern Plains | 89.33 | .81 | 5.36 | 4.50 | — |
| Appalachian | 94.07 | 1.95 | .34 | 3.65 | — |
| Southeast | — | — | 100.00 | — | — |
| Delta States | 100.00 | — | — | — | — |
| Southern Plains | 92.68 | — | 4.71 | 2.60 | — |
| Mountain | 76.19 | 9.94 | 1.69 | 10.96 | 1.22 |
| Pacific | 100.00 | — | — | — | — |
| Dry, mixtures, lime | | | | | |
| Northeast | — | 2.16 | — | 97.84 | — |
| Lake States | 92.65 | 1.61 | 3.75 | 1.99 | — |
| Corn Belt | 90.71 | 1.66 | 3.57 | 3.67 | .39 |
| Northern Plains | 85.43 | 2.22 | 6.48 | 5.87 | — |
| Appalachian | 87.79 | 6.64 | 3.22 | 1.95 | .40 |
| Southeast | 100.00 | — | — | — | — |
| Delta States | 81.35 | 8.00 | 8.36 | 2.29 | — |
| Southern Plains | 85.75 | 1.29 | 7.94 | 4.94 | .08 |
| Mountain | 90.30 | 2.42 | 3.57 | 3.55 | .17 |
| Pacific | 60.98 | 9.93 | 25.16 | 3.93 | — |
| Liquid | | | | | |
| Northeast | — | — | — | — | — |
| Lake States | 86.76 | 2.01 | 10.03 | 1.19 | — |
| Corn Belt | 89.09 | .61 | 6.80 | 3.50 | — |
| Northern Plains | 90.96 | 2.35 | 4.32 | 2.38 | — |
| Appalachian | 47.84 | .95 | 20.44 | 30.78 | — |
| Southeast | 100.00 | — | — | — | — |
| Delta States | 85.48 | 12.30 | — | 2.22 | — |
| Southern Plains | 76.54 | .03 | 13.69 | 9.73 | — |
| Mountain | 54.52 | 11.56 | 6.14 | 25.09 | 2.68 |
| Pacific | 27.11 | — | 72.89 | — | — |

— = No responses.

fertilizer, and the desire of farmers and the agricultural input providers (i.e., cooperatives) to limit the impact of fertilizer use on the environment. Twenty-two (LS) to 24 percent (CB) of the cooperatives sold, rented, or leased GPS units while 39 percent (LS) would like to do so-30 percent, CB; 42 percent, SP; 40 percent, NP; 37 percent, MT; 33 percent, DS; and 27 percent, SE.

Application equipment with GPS was offered by 50 percent of the respondents in the CB and 25 percent in LS. Another 26 percent would like to offer it in CB; 41 percent, LS; 52 percent, NP; 42 percent, SP; 41 percent, MT; and 40 percent, DS.

For the cooperative to apply fertilizers with GPS equipment, field maps have to be generated. These maps are generally segmented in 2.5- to five-acre grids and fertilizers are applied in the individual grids based on soil tests and past yields. The maps are only as good as their interpretation. Many farmers rely on outside help. In the CB and LS, where 54 percent and 39 percent of the respondents, respectively, provide field mapping, cooperatives also employ fertilizer specialists more than 86 percent of the time. While the survey did not specifically ask if the cooperative provided interpretation of the GPS/GIS information, it

Table 15—Top three competitors and type of competition for cooperatives by region, weighted by sales

| Competitor | Manufacturer | Dealer | Private supplier | Other cooperative | Type of competition: Price | Service and availability | Quality, service and product |
|---|---|---|---|---|---|---|---|
| | | | | Percent | | | |
| Number One | | | | | | | |
| Northeast | — | | — | 97.99 | 50.21 | 24.89 | 24.89 |
| Lake States | 12.43 | | 29.21 | 54.75 | 57.30 | 19.03 | 23.68 |
| Corn Belt | 17.15 | 5.58 | 41.98 | 35.29 | 40.67 | 28.99 | 30.34 |
| Northern Plains | 10.67 | 5.23 | 41.07 | 43.03 | 51.80 | 26.49 | 21.71 |
| Appalachian | 13.21 | 17.66 | 43.04 | 26.09 | 55.28 | 25.14 | 19.58 |
| Southeast | | 23.47 | 60.94 | — | 18.75 | 15.54 | 65.71 |
| Delta States | — | 40.50 | 13.57 | 45.93 | 48.28 | 31.92 | 19.80 |
| Southern Plains | | 3.90 | 53.33 | 22.34 | 54.61 | 26.59 | 18.81 |
| Mountain | | 5.99 | 12.16 | 57.48 | 41.97 | 25.31 | 32.72 |
| Pacific | | 26.97 | 49.85 | — | 53.68 | 35.09 | 11.23 |
| Number Two [1] | | | | | | | |
| Northeast | — | 2.01 | 97.99 | — | 50.90 | 24.55 | 24.55 |
| Lake States | | 1.08 | 36.46 | 54.39 | 46.94 | 22.98 | 25.75 |
| Corn Belt | | 3.76 | 44.53 | 40.31 | 39.75 | 28.73 | 29.40 |
| Northern Plains | | 6.46 | 36.63 | 49.72 | 47.04 | 29.82 | 20.74 |
| Appalachian | | 22.48 | 30.17 | 26.19 | 40.90 | 30.34 | 16.74 |
| Southeast | | 27.08 | — | 51.37 | 51.47 | 7.75 | 34.83 |
| Delta States | | — | 75.71 | 14.47 | 34.77 | 30.08 | 29.56 |
| Southern Plains | | 13.00 | 40.68 | 22.71 | 42.44 | 30.82 | 20.14 |
| Mountain | | 5.61 | 44.63 | 29.85 | 34.51 | 35.21 | 26.83 |
| Pacific | | 6.43 | 44.92 | 18.17 | 71.27 | 20.44 | 8.30 |
| Number Three [1] | | | | | | | |
| Northeast | — | 25.60 | 72.38 | — | 50.21 | 23.89 | 23.89 |
| Lake States | | 4.71 | 33.81 | 39.81 | 54.90 | 17.05 | 16.42 |
| Corn Belt | | 6.08 | 42.41 | 31.28 | 37.49 | 23.15 | 29.23 |
| Northern Plains | | 18.61 | 25.75 | 35.11 | 51.36 | 20.37 | 19.14 |
| Appalachian | — | 6.78 | 22.25 | 49.41 | 39.12 | 25.08 | 14.23 |
| Southeast | | — | 43.49 | — | 43.49 | — | 27.08 |
| Delta States | — | 4.23 | 9.92 | 46.06 | 28.66 | 27.64 | 3.90 |
| Southern Plains | | 14.63 | 24.71 | 25.16 | 35.19 | 32.99 | 9.92 |
| Mountain | | 14.90 | 42.27 | 28.78 | 49.67 | 11.42 | 35.46 |
| Pacific | — | 31.06 | 62.48 | 6.46 | 36.52 | 10.04 | 53.44 |

[1] Values for competitors two and three do not add to 100 as not all cooperatives had more than one competitor.
No responses.

would be a safe assumption given the equipment and services.

In the NP, 47 percent of the cooperatives would like to offer field mapping; 41 percent, MT; and 40 percent, DS. Computer record keeping using GPS/GIS information was provided by 42 percent of the cooperatives in the CB and 34 percent in LS. But, 47 percent of the cooperatives in MT would like to do so; 43 percent, NP; 42 percent, SP; and 40 percent, DS.

## Size and Type Comparison

Prior studies using the Rural Business-Cooperative Service database have found differences in cooperative operations when the cooperatives were classified by size and type. Cooperatives in this study were also divided into four sizes and types, using criteria established in prior reports (table 19).

Fertilizer sales growth over the 11-year period increased about 10 percent per year for small, medium, and large cooperatives, and a little more than 11 percent for super cooperatives. By cooperative type, fertilizer

**Table 16— Equipment offered to farmers for fertilizer application and how their cost is recovered by region, weighted by sales**

| Equipment | Currently offer | Would like to offer | Cost recovery method: include cost in product price | Cost recovery method: Additional service charge |
|---|---|---|---|---|
| | | | *Percent* | |
| Dry fertilizer applicators | | | | |
| Northeast | 97.99 | — | 36.94 | 63.06 |
| Lake States | 97.88 | — | 24.41 | 75.59 |
| Corn Belt | 93.64 | 1.48 | 17.17 | 82.83 |
| Northern Plains | 86.68 | — | 15.56 | 84.44 |
| Appalachian | 95.80 | 4.20 | 42.66 | 57.34 |
| Southeast | 94.04 | — | 45.37 | 54.63 |
| Delta States | 100.00 | — | 59.76 | 40.24 |
| Southern Plains | 92.73 | 1.37 | 60.64 | 39.36 |
| Mountain | 90.70 | — | 33.81 | 66.19 |
| Pacific | 60.45 | — | 10.63 | 89.37 |
| Anhydrous ammonia nurse tanks | | | | |
| Northeast | — | — | — | — |
| Lake States | 90.89 | 1.53 | 61.02 | 38.98 |
| Corn Belt | 94.23 | .64 | 60.24 | 39.76 |
| Northern Plains | 97.74 | .48 | 62.09 | 37.91 |
| Appalachian | 12.87 | 3.09 | 20.51 | 79.49 |
| Southeast | — | — | — | — |
| Delta States | 29.19 | — | 5.96 | 94.04 |
| Southern Plains | 67.95 | 2.36 | 86.66 | 13.34 |
| Mountain | 69.45 | — | 72.21 | 27.79 |
| Pacific | 29.60 | — | 100.00 | — |
| Anhydrous ammonia tool bars | | | | |
| Northeast | — | — | — | — |
| Lake States | 87.90 | 1.91 | 37.59 | 62.41 |
| Corn Belt | 92.62 | .64 | 24.98 | 75.02 |
| Northern Plains | 80.72 | .28 | 13.04 | 86.96 |
| Appalachian | 10.23 | — | — | 100.00 |
| Southeast | — | — | — | — |
| Delta States | — | — | — | — |
| Southern Plains | 56.99 | 2.36 | 23.76 | 76.24 |
| Mountain | 55.82 | — | 28.55 | 71.45 |
| Pacific | 34.54 | | 100.00 | — |

— = No responses.

sales growth was about 11 percent for farm supply cooperatives; 8 percent for mixed farm supply; 10 percent, mixed marketing and 12 percent, marketing cooperatives. Some of this growth was fueled by mergers, consolidations, and acquisitions. Small cooperatives experienced 2 mergers between 1992 and 1996; medium, 7 mergers;

Table 17—**Fertilizer** services provided with cooperative personnel and equipment and how their cost is recovered by region, weighted by sales

| Service | Currently offer | Would like to offer | Cost recovery method: Include cost in product price | Cost recovery method: Additional service charge |
|---|---|---|---|---|
| | | | Percent | |
| **Application** | | | | |
| **Northeast** | 97.99 | — | 36.94 | 63.06 |
| Lake States | 98.45 | 0.36 | 4.77 | 95.23 |
| **Corn Belt** | 98.74 | — | 8.68 | 91.32 |
| **Northern Plains** | 95.46 | 1.17 | 3.37 | 96.63 |
| Appalachian | 64.52 | 2.25 | 20.65 | 79.35 |
| Southeast | 70.57 | — | 39.54 | 60.46 |
| Delta States | 73.50 | 8.18 | 2.37 | 97.63 |
| Southern Plains | 91.92 | 3.73 | 19.38 | 80.62 |
| Mountain | 94.11 | — | 4.94 | 95.06 |
| Pacific | 70.36 | 6.46 | 32.39 | 67.61 |
| **Soil testing** | | | | |
| **Northeast** | 97.99 | — | 73.87 | 26.13 |
| Lake States | 98.38 | .48 | 20.85 | 79.15 |
| Corn Belt | 97.02 | — | 55.04 | 44.96 |
| Northern Plains | 86.43 | 3.28 | 24.15 | 75.85 |
| Appalachian | 82.29 | — | 79.43 | 20.57 |
| Southeast | 70.57 | — | 77.92 | 22.08 |
| Delta States | 72.08 | 1.74 | 67.07 | 32.93 |
| Southern Plains | 87.68 | 10.89 | 55.19 | 44.81 |
| Mountain | 96.59 | — | 19.60 | 80.40 |
| Pacific | 75.80 | — | 23.51 | 76.49 |
| **Specialists** | | | | |
| **Northeast** | 72.38 | 25.60 | 100.00 | — |
| Lake States | 91.62 | 5.24 | 58.89 | 41.11 |
| Corn Belt | 86.42 | 7.59 | 78.37 | 21.63 |
| Northern Plains | 66.55 | 10.52 | 38.67 | 61.33 |
| Appalachian | 70.24 | 8.13 | 95.95 | 4.05 |
| Southeast | 43.49 | — | 100.00 | — |
| Delta States | 60.52 | 8.18 | 48.22 | 51.78 |
| Southern Plains | 47.88 | 21.35 | 79.85 | 20.15 |
| Mountain | 67.38 | 14.68 | 65.50 | 34.50 |
| Pacific | 75.80 | — | 100.00 | — |
| **Computer records** | | | | |
| **Northeast** | — | 25.60 | — | — |
| Lake States | 76.64 | 7.78 | 73.10 | 26.90 |
| Corn Belt | 67.73 | 17.55 | 82.58 | 17.42 |
| Northern Plains | 57.81 | 18.35 | 74.51 | 25.49 |
| Appalachian | 64.46 | 7.14 | 90.21 | 9.79 |
| Southeast | 66.14 | 27.90 | 100.00 | — |
| Delta States | 35.35 | 33.14 | 100.00 | — |
| Southern Plains | 54.02 | 15.21 | 64.83 | 35.17 |
| Mountain | 61.57 | 11.31 | 70.19 | 29.81 |
| Pacific | 51.57 | 11.42 | 60.23 | 39.77 |

large, 14; and super, 37. By cooperative type, farm supply and mixed farm supply cooperatives had 11 mergers; mixed marketing, 22 mergers; and marketing, 16.

Fertilizer sales were the lowest for small cooperatives, at $1 million, and increased with co-op size to $3.4 million for super cooperatives. All cooperative types

**Table 18— GPS and GIS services and equipment provided and how the cost is recovered for cooperatives using GPS/GIS field mapping by region, weighted by sales**

| Service | Currently offer | Would like to offer | Cost recovery method: Include cost in product price | Cost recovery method: Additional service charge |
|---|---|---|---|---|
| | | | *Percent* | |
| **Sell, rent, or lease GPS units** | | | | |
| Northeast | — | — | — | — |
| Lake States | 22.42 | 38.53 | 21.66 | 78.34 |
| Corn Belt | 24.22 | 29.76 | 5.69 | 94.31 |
| Northern Plains | 4.22 | 39.99 | 28.75 | 71.25 |
| Appalachian | 4.24 | 10.61 | 100.00 | — |
| Southeast | — | 27.08 | — | — |
| Delta States | — | 33.08 | — | — |
| Southern Plains | 4.05 | 41.60 | 100.00 | — |
| Mountain | 6.32 | 36.98 | — | 100.00 |
| Pacific | — | 20.51 | — | — |
| Application with GPS | | | | |
| Northeast | — | — | — | — |
| Lake States | 24.88 | 40.72 | 29.38 | 70.62 |
| Corn Belt | 49.54 | 25.64 | 8.38 | 91.62 |
| Northern Plains | 4.55 | 51.72 | — | 100.00 |
| Appalachian | 4.12 | 16.72 | — | 100.00 |
| Southeast | — | 27.08 | — | — |
| Delta States | 1.74 | 39.51 | — | 100.00 |
| Southern Plains | 4.05 | 41.60 | 100.00 | — |
| Mountain | 9.09 | 40.72 | — | 100.00 |
| Pacific | — | 20.51 | — | — |
| Field mapping with GPS/GIS | | | | |
| Northeast | — | — | — | — |
| Lake States | 39.27 | 33.17 | 26.18 | 73.82 |
| Corn Belt | 54.37 | 27.19 | 12.21 | 87.79 |
| Northern Plains | 15.70 | 46.69 | — | 100.00 |
| Appalachian | 9.03 | 23.02 | — | 100.00 |
| Southeast | — | 27.08 | — | — |
| Delta States | 1.74 | 39.51 | — | 100.00 |
| Southern Plains | 12.87 | 32.79 | 31.48 | 68.52 |
| Mountain | 9.09 | 40.72 | — | 100.00 |
| Pacific | — | 20.51 | — | — |
| Computer records with GPS/GIS | | | | |
| Northeast | — | — | — | — |
| Lake States | 34.27 | 36.21 | 42.93 | 57.07 |
| Corn Belt | 41.78 | 34.26 | 15.97 | 84.03 |
| Northern Plains | 15.07 | 42.76 | 37.79 | 62.21 |
| Appalachian | 9.03 | 18.86 | — | 100.00 |
| Southeast | — | 27.08 | — | — |
| Delta States | 1.74 | 39.51 | — | 100.00 |
| Southern Plains | 4.05 | 41.60 | 100.00 | — |
| Mountain | 2.76 | 47.04 | — | 100.00 |
| Pacific | 20.51 | — | — | 100.00 |

averaged about $2 million in fertilizer sales. Mixed farm supply and mixed marketing co-ops had slightly higher averages than farm supply and marketing cooperatives.

Kinds of fertilizers sold, sources, competitors, and competition analyzed by cooperative size and type followed trends found in previous sections. Dry, mixtures, and lime were the most frequent fertilizers sold and usually provided by regional cooperatives. The primary competitor was either a private supplier or another cooperative. And, price was the type of competition most often faced by respondent cooperatives.

Equipment offered to farmers for fertilizer application varied the most by cooperative size. Small cooperatives provided the equipment less frequently than super cooperatives (appendix table 5). By cooperative type, mixed farm supply and mixed marketing cooperatives tended to offer the equipment slightly more often than farm supply and marketing cooperatives.

The cost of fertilizer application and soil testing was recovered most often by an additional service charge across cooperative size and type (table 20). Small cooperatives were less likely to offer application and soil testing than larger cooperatives. By type, mixed farm supply and mixed marketing cooperatives offered application and soil testing more often than farm supply or marketing cooperatives did.

Fertilizer specialists and computer record keeping costs were most often included in the price of fertilizer. Both of these services were offered more frequently by larger cooperatives. Farm supply cooperatives offered both of these services about 70 percent of the time. Other types of cooperatives were more likely to have a fertilizer specialist than keep fertilizer records on the computer.

More GPS/GIS services and equipment were offered as cooperative size increased (table 21). These services and equipment were usually paid for through an additional service charge. Application equipment with GPS was offered by 8 percent of the small cooperatives; 11 percent, medium; 17 percent, large; and 38 percent, super. By type, farm supply cooperatives had application equipment with GPS 29 percent of the time; mixed farm supply, 20 percent; mixed marketing, 24 percent; and marketing cooperatives, 26 percent. Many cooperatives of all sizes and types that do not currently offer application with GPS would like to do so-22 percent for small cooperatives to 43 percent for mixed marketing cooperatives.

Field mapping, the precision agriculture service offered most often, was available for more than 50 percent of super cooperative's fertilizer volume. Another 31 percent want to add the service. Farm supply and mixed farm supply cooperatives offered field mapping about 30 percent of the time. Another 37 percent of these cooperatives would like to do so. Among mixed marketing cooperatives, 35 percent offered field mapping with GPS/GIS. An additional 40 percent hope to do so. For marketing cooperatives, 40 percent offered the service and an additional 31 percent are considering it.

## Prior Survey Comparisons

In 1985, cooperatives that sold $0.5 million of fertilizer and crop protectants were surveyed about volume sold, product sources, competitors, trade radius, sales trends, services offered in conjunction with sales, and important factors in keeping and gaining patrons. Parts of the 1996 survey were comparable with the prior survey. Of the 867 respondents in the 1985 survey, 234 or 27 percent no longer exist, having merged, consolidated, or gone out of business. This section looks briefly at the 258 cooperatives that responded to both the 1985 and 1996 surveys.

Annual fertilizer sales growth for the 1985 respondents was 6.6 percent per year from 1983

**Table 19—Size and type definitions, number, sales growth, and average fertilizer sales**

| Cooperative size | Definition | cooperatives | Sales growth | Fertilizer sales |
|---|---|---|---|---|
| | | *Number* | *Percent* | *Dollars* |
| Small | up to $5 million in total sales | 63 | 9.76 | 1,013,389 |
| Medium | $5 million to $10 million | 134 | 9.83 | 1,316,749 |
| Large | $10 million to $20 million | 156 | 9.84 | 1,987,984 |
| Super | $20 million and more | 144 | 11.18 | 3,401 ,146 |
| **Cooperative type** | | | | |
| Farm supply | total net sales from farm supplies | 194 | 10.66 | 2,027,529 |
| Mixed farm supply | from 50 to 99 percent | 92 | 7.66 | 2,165,789 |
| Mixed marketing | from 25 to 49 percent | 119 | 9.92 | 2,209,583 |
| Marketing | less than 25 percent | 92 | 12.18 | 1,992,078 |

through 1985, but only 5.7 percent in the current survey. Average fertilizer sales increased from $1.4 million in 1985 to $2.3 million in 1996. Then and now, regional cooperatives provided about 90 percent of fertilizers sold.

In sheer numbers, other cooperatives were an important competitor in fertilizer sales, trailing private suppliers and dealers in 1985. The 1996 survey sought to find the toughest instead of the most numerous competitor. A private supplier and another cooperative were very closely rated as the number one or two competitor for most cooperatives.

Fertilizer price was found to be the second most important tool for keeping fertilizer patrons in 1985 (application was most important) and price was also the second most important tool in gaining new patrons, following advertizing. Price was the strongest competition faced by all cooperatives in 1996.

Table 20— Fertilizer services provided with cooperative personnel and equipment and how their cost is recovered by cooperative size and type, weighted by sales

| Service | Currently offer | Would like to offer | Cost recovery method: Include cost in product price | Cost recovery method: Additional service charge |
|---|---|---|---|---|
| | Percent | | | |
| **Application** | | | | |
| **Small** | **87.72** | 1.34 | **8.94** | 91.06 |
| Medium | 88.61 | 2.59 | 9.45 | 90.55 |
| Large | 95.95 | .73 | 8.22 | 91.78 |
| Super | 98.51 | .29 | 7.16 | 92.84 |
| Farm supply | 92.46 | .89 | 8.55 | 91.45 |
| Mixed farm supply | 97.85 | .64 | 7.46 | 92.54 |
| Mixed marketing | 98.41 | .92 | 5.15 | 94.85 |
| Marketing | 94.68 | 1.02 | 11.37 | 88.63 |
| **Soil testing** | | | | |
| **Small** | 82.40 | 4.68 | 29.37 | 70.63 |
| Medium | 86.94 | 2.83 | 44.43 | 55.57 |
| Large | 93.73 | 1.87 | 42.11 | 57.89 |
| Super | 95.44 | .oo | 37.84 | 62.16 |
| Farm supply | 88.20 | 2.63 | 38.33 | 61.67 |
| Mixed farm supply | 97.55 | — | 49.39 | 50.61 |
| Mixed marketing | 97.47 | .40 | 64.89 | 35.11 |
| Marketing | 89.25 | .64 | 32.39 | 67.61 |
| **Specialists** | | | | |
| **Small** | 58.90 | 11.80 | 75.35 | 24.65 |
| Medium | 56.79 | 17.88 | 70.13 | 29.87 |
| Large | 78.73 | 7.70 | 64.40 | 35.60 |
| Super | 88.48 | 5.47 | 65.84 | 34.16 |
| Farm supply | 69.35 | 10.62 | 73.58 | 26.42 |
| Mixed farm supply | 87.02 | 8.36 | 65.28 | 34.72 |
| Mixed marketing | 98.04 | .88 | 38.94 | 61.06 |
| Marketing | 77.94 | 7.56 | 64.39 | 35.61 |
| **Computer records** | | | | |
| **Small** | 56.55 | 22.27 | 86.08 | 13.92 |
| Medium | 55.36 | 16.79 | 86.76 | 13.24 |
| Large | 61.94 | 17.77 | 69.48 | 30.52 |
| Super | 72.14 | 11.33 | 78.79 | 21.21 |
| Farm supply | 68.86 | 13.46 | 85.84 | 14.16 |
| Mixed farm supply | 64.94 | 17.48 | 68.58 | 31.42 |
| Mixed marketing | 61.07 | 14.87 | 72.67 | 27.33 |
| Marketing | 64.02 | 14.99 | 75.90 | 24.10 |

— = No responses.

Fertilizer application and application equipment were important in keeping patrons in 1985. Only one cooperative that offered its members equipment to apply fertilizer on their own did not do so in 1996. Nine cooperatives that applied fertilizer in 1985 no longer did so in 1996. Even though they had dropped the service, three cooperatives indicated that they would like to be able to offer fertilizer application.

Part of the 1985 survey drew attention to the then relatively new trend of low-input sustainable agriculture. Soil testing and crop management specialists were found as necessary tools the cooperative could use to help farmers lower their use of inputs. Low-input agriculture is still used, but the new trend is toward precision agriculture that uses GPS/GIS technology. Soil testing and crop management specialists are still very important with this new technology. Soil testing was done by 10 more cooperatives in 1985 than in 1996, although 3 of those that dropped the service would like to offer it again. Crop management special-

**Table 21— GPS and GIS services and equipment provided and how the cost is recovered for cooperatives using GPS/GIS field mapping by cooperative size and type, weighted by sales**

| Service | Currently offer | Would like to offer | Cost recovery method: Include cost in product price | Cost recovery method: Additional service charge |
|---|---|---|---|---|
| | | Percent | | |
| Sell, rent, or lease GPS units | | | | |
| Small | 7.64 | 22.13 | — | 100.00 |
| Medium | 6.16 | 28.37 | 25.66 | 74.34 |
| Large | 10.36 | 39.79 | 27.45 | 72.55 |
| Super | 22.59 | 33.08 | 10.25 | 89.75 |
| Farm supply | 17.24 | 27.83 | 17.21 | 82.79 |
| Mixed farm supply | 9.57 | 41.13 | — | 100.00 |
| Mixed marketing | 14.16 | 37.84 | 18.04 | 81.96 |
| Marketing | 18.54 | 31.70 | 13.39 | 86.61 |
| Application with GPS | | | | |
| Small | 7.64 | 22.13 | — | 100.00 |
| Medium | 11.10 | 29.86 | 2.46 | 97.54 |
| Large | 16.88 | 42.01 | 2.77 | 97.23 |
| Super | 37.67 | 35.27 | 16.50 | 83.50 |
| Farm supply | 28.63 | 29.91 | 10.54 | 89.46 |
| Mixed farm supply | 19.58 | 36.97 | 14.64 | 85.36 |
| Mixed marketing | 23.71 | 43.04 | 16.47 | 83.53 |
| Marketing | 25.55 | 37.11 | 12.08 | 87.92 |
| Field mapping with GPS/GIS | | | | |
| Small | 10.74 | 28.75 | — | 100.00 |
| Medium | 15.17 | 29.34 | 9.88 | 97.54 |
| Large | 19.63 | 41.29 | 9.06 | 90.94 |
| Super | 50.97 | 31.02 | 16.58 | 83.42 |
| Farm supply | 30.04 | 29.36 | 19.83 | 80.17 |
| Mixed farm supply | 30.13 | 36.58 | 2.42 | 97.58 |
| Mixed marketing | 34.69 | 39.61 | 16.92 | 83.08 |
| Marketing | 40.17 | 31.17 | 12.32 | 87.68 |
| Computer records with GPS/GIS | | | | |
| Small | 7.92 | 28.35 | 25.28 | 74.72 |
| Medium | 11.76 | 30.34 | 9.88 | 90.12 |
| Large | 17.30 | 41.41 | 13.39 | 86.61 |
| Super | 41.00 | 36.04 | 29.08 | 70.92 |
| Farm supply | 25.42 | 30.87 | 19.61 | 80.39 |
| Mixed farm supply | 28.06 | 33.86 | 15.30 | 84.70 |
| Mixed marketing | 25.16 | 45.50 | 33.78 | 66.22 |
| Marketing | 31.28 | 36.54 | 38.20 | 61.80 |

ists were offered by 16 more cooperatives in 1985, but 7 who lost them again wanted to have them in 1996.

Cost may be the biggest factor why 9 cooperatives no longer apply fertilizer, 10 do not test soil, and 16 no longer employ crop management specialists. These three services, while important in keeping fertilizer customers in 1985, are expensive. Fertilizer application requires expensive equipment and well-trained operators. Soil testing, especially in grids, is labor intensive. Trained crop management specialists and fertilizer applicators have a skill that can command a higher salary at another cooperative or other competitor.

## Summary and Conclusions

Local cooperatives studied in this report generally had strong growth in fertilizer sales- more than 10 percent on average per year from 1985 through 1996. These cooperatives supported the cooperative agricultural inputs system, purchasing more than 80 percent of their liquid fertilizers; 89 percent of their dry, mixtures, and lime; and 92 percent of their anhydrous ammonia from regional cooperatives.

The respondent cooperatives sold almost $1.1 billion worth of the $3.2 billion worth of fertilizers sold by local agricultural cooperatives in 1996. Their primary competitor for fertilizer sales to farmers was a private supplier, closely followed by another cooperative. Fertilizer price was the strongest form of sales competition, but competition based on service and availability of product, as well as quality of service and product was also evident.

Most cooperatives provided fertilizer application equipment to the farmers. The cooperatives also applied fertilizer using their own equipment and personnel. Soil tests were often provided to determine nutrient needs and fertilizer specialists to assist the farmer in making decisions. Many cooperatives also provided a computerized record service to track farmers' use of fertilizers.

Precision agriculture's use of GPS/GIS technology has been championed by local agricultural cooperatives. Field mapping is available to about 30 percent of the fertilizer volume.

There were large regional differences in use of precision agriculture. The Corn Belt and Lake States appeared to be early adopters of the technology because of use of nitrogen-based fertilizers to support large amounts of corn grown. The GPS/GIS technology is expensive, so larger cooperatives were more likely to offer it. Almost a third of all respondents want to offer it in the future.

Compared with cooperative fertilizer operations in 1985, there were many similar responses. Local cooperatives were still strongly supported by the regional cooperative procurement and distribution system. Private suppliers and other cooperatives were strong competitors, especially on price. Low-input sustainable agriculture is still practiced, but it is evolving into precision agriculture.

Precision agriculture, with fertilizers used only where needed, was an excellent partner to farmers' stewardship of natural resources and their cooperatives' provision of valuable fertilizer services and equipment. Cooperative fertiiizer application equipment with GPS/GIS technology combined with farmers' use of it to vary plant populations on planters in the spring and check yields with monitors on harvesting equipment in the fall is an example of integrated use of the technology.

With all this information, most farmers need help in interpretation. Local cooperatives, with long experience in fertilizer application and employing fertilizer specialists, are natural providers of field maps. Working with regional cooperative personnel, local cooperatives have provided fertilizer record keeping programs and innovative ways to combine field maps, yield monitors, and fertilizer application equipment.

Precision agriculture is expensive. Almost one-third of the respondents that do not offer the technology would like to do so, but may be unable due to the high fixed costs and large volume of fertilizer required. Smaller cooperatives may be able to offer GPS/GIS application units by purchasing the equipment with another cooperative(s) and sharing the use and expenses. These cooperatives might also consider setting up a fertilizer subsidiary to share the use and expenses. Adding a fertilizer specialist to help the farmer interpret the information also may be affordable if shared by several cooperatives.

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## Appendix table 1- Sources of fertilizer by quartile rankings, weighted by sales

| Fertilizer | Regional cooperative | Other cooperative | Private manufacturer | Private supplier | Other |
|---|---|---|---|---|---|
| | | | *Percent* | | |
| **Anhydrous ammonia** | | | | | |
| Quartile 1 | 91.35 | 0.97 | 4.81 | 2.88 | — |
| Quartile 2 | 90.89 | .72 | 3.82 | 4.32 | 0.25 |
| Quartile 3 | 93.68 | .07 | 1.41 | 4.85 | — |
| Quartile 4 | 92.58 | 2.70 | 2.00 | 2.73 | — |
| Quartile 5 | 92.40 | .07 | 7.33 | 0.20 | — |
| **Dry, mixtures, lime** | | | | | |
| Quartile 1 | 93.07 | 1.29 | 3.47 | 2.17 | — |
| Quartile 2 | 88.79 | 1.40 | 5.72 | 4.02 | .06 |
| Quartile 3 | 85.49 | 2.72 | 6.21 | 5.32 | .25 |
| Quartile 4 | 84.63 | 5.51 | 5.20 | 4.21 | .44 |
| Quartile 5 | 91.97 | 2.08 | 2.72 | 3.01 | .22 |
| **Liquid** | | | | | |
| Quartile 1 | 84.40 | 2.90 | 10.08 | 2.63 | — |
| Quartile 2 | 79.80 | 2.00 | 5.03 | 12.09 | 1.08 |
| Quartile 3 | 92.53 | .14 | 3.85 | 3.48 | — |
| Quartile 4 | 72.57 | 5.99 | 16.82 | 4.62 | — |
| Quartile 5 | 90.17 | .13 | 5.66 | 4.04 | — |

— = No responses.

## Appendix table 2— Top three competitors by quartile ranking and type of competition, weighted by sales

| Competitor | Manufacturer | Dealer | Private supplier | Other cooperative | Type of competition: Price | Type of competition: Service and availability | Type of competition: Quality service and product |
|---|---|---|---|---|---|---|---|
| | | | | *Percent* | | | |
| **Number One** | | | | | | | |
| Quartile 1 | 12.43 | 3.26 | 28.46 | 55.85 | 49.25 | 27.44 | 23.31 |
| Quartile 2 | 11.15 | 5.39 | 41.94 | 41.52 | 46.08 | 28.53 | 25.40 |
| Quartile 3 | 8.62 | 12.58 | 41.24 | 37.56 | 53.67 | 19.80 | 26.53 |
| Quartile 4 | 17.96 | 6.51 | 34.27 | 41.26 | 48.58 | 23.51 | 27.91 |
| Quartile 5 | 27.30 | 7.83 | 45.21 | 19.66 | 43.27 | 29.36 | 27.37 |
| **Number Two [1]** | | | | | | | |
| Quartile 1 | 4.17 | 4.91 | 38.78 | 47.49 | 38.82 | 27.58 | 28.97 |
| Quartile 2 | 11.95 | 2.35 | 40.99 | 41.24 | 48.89 | 20.96 | 26.67 |
| Quartile 3 | 6.01 | 5.82 | 37.56 | 49.15 | 47.20 | 27.78 | 23.55 |
| Quartile 4 | 8.46 | 6.13 | 51.13 | 28.67 | 44.70 | 28.19 | 21.50 |
| Quartile 5 | 12.02 | 9.52 | 33.26 | 43.30 | 37.40 | 37.74 | 22.97 |
| **Number Three [1]** | | | | | | | |
| Quartile 1 | 13.12 | 7.56 | 38.34 | 30.03 | 45.84 | 20.15 | 23.06 |
| Quartile 2 | 11.70 | 11.12 | 33.48 | 31.24 | 47.67 | 18.09 | 21.78 |
| Quartile 3 | 7.68 | 11.77 | 38.49 | 32.42 | 49.76 | 18.12 | 22.48 |
| Quartile 4 | 7.14 | 12.04 | 28.48 | 35.95 | 40.82 | 21.68 | 21.12 |
| Quartile 5 | 7.55 | 7.50 | 34.16 | 43.36 | 38.89 | 26.71 | 26.96 |

[1] Values for competitors two and three do not add to 100 as not all cooperatives had more than one competitor.

**Appendix table 3— Equipment offered to farmers for fertilizer application by quartile ranking and how their cost is recovered, weighted by sales**

| Equipment | Currently offer | Would like to offer | Cost recovery method: Include cost in product price | Cost recovery method: Additional service charge |
|---|---|---|---|---|
| | | | *Percent* | |
| **Dry fertilizer applicators** | | | | |
| Quartile 1 | 89.02 | 2.08 | 26.07 | 73.93 |
| Quartile 2 | 94.73 | — | 22.68 | 77.32 |
| Quartile 3 | 98.53 | 1.19 | 29.75 | 70.25 |
| Quartile 4 | 92.05 | .32 | 24.27 | 75.73 |
| Quartile 5 | 87.98 | — | 13.31 | 86.69 |
| **Anhydrous ammonia nurse tanks** | | | | |
| Quartile 1 | 88.33 | 1.50 | 61.43 | 38.57 |
| Quartile 2 | 88.97 | .59 | 57.02 | 42.98 |
| Quartile 3 | 77.82 | 1.67 | 67.49 | 32.51 |
| Quartile 4 | 80.09 | — | 68.77 | 31.23 |
| Quartile 5 | 81.56 | .66 | 56.43 | 43.57 |
| **Anhydrous ammonia tool bars** | | | | |
| Quartile 1 | 75.66 | 1.32 | 29.34 | *70.66* |
| Quartile 2 | 78.48 | .59 | 24.63 | *75.37* |
| Quartile 3 | 76.47 | .79 | 24.10 | *75.90* |
| Quartile 4 | 78.19 | — | 21.35 | *78.65* |
| Quartile 5 | 76.46 | 1.16 | 29.06 | *70.94* |

— = No responses.

Appendix table 4— **Fertilizer services provided with cooperative personnel and equipment by quartile ranking and how their cost is recovered, weighted by sales**

| Service | Currently offer | Would like to offer | Cost recovery method: Include cost in product price | Cost recovery method: Additional service charge |
|---|---|---|---|---|
| | | | *Percent* | |
| **Application** | | | | |
| Quartile 1 | 95.66 | 0.90 | 6.10 | 93.90 |
| Quartile 2 | 96.12 | .44 | 7.61 | 92.39 |
| Quartile 3 | 96.66 | .72 | 6.36 | 93.64 |
| Quartile 4 | 93.59 | .32 | 13.88 | 86.12 |
| Quartile 5 | 94.56 | 2.20 | 6.65 | 93.35 |
| **Soil testing** | | | | |
| Quartile 1 | 90.22 | 2.80 | 38.46 | 61.54 |
| Quartile 2 | 92.94 | 1.32 | 39.44 | 60.56 |
| Quartile 3 | 94.54 | .35 | 46.15 | 53.85 |
| Quartile 4 | 91.46 | 1.33 | 36.56 | 63.44 |
| Quartile 5 | 95.37 | .18 | 37.76 | 62.24 |
| **Specialists** | | | | |
| Quartile 1 | 70.98 | 12.91 | 55.58 | 44.42 |
| Quartile 2 | 82.91 | 10.04 | 65.00 | 35.00 |
| Quartile 3 | 82.71 | 5.56 | 65.85 | 34.15 |
| Quartile 4 | 80.71 | 4.89 | 73.93 | 26.07 |
| Quartile 5 | 76.24 | 8.27 | 75.87 | 24.13 |
| **Computer records** | | | | |
| Quartile 1 | 69.36 | 14.02 | 77.43 | 22.57 |
| Quartile 2 | 71.39 | 10.60 | 76.38 | 23.62 |
| Quartile 3 | 62.72 | 19.12 | 84.63 | 15.37 |
| Quartile 4 | 55.80 | 14.77 | 71.28 | 28.72 |
| Quartile 5 | 64.58 | 16.71 | 78.19 | 21.81 |

**Appendix table 5— Equipment offered to farmers for fertilizer application and how their cost is recovered by cooperative size and type, weighted by sales**

| Equipment | Currently offer | Would like to offer | Cost recovery method: Include cost in product price | Cost recovery method: Additional service charge |
|---|---|---|---|---|
| | | | *Percent* | |
| **Dry** fertilizer applicators | | | | |
| Small | 86.55 | — | 26.79 | 73.21 |
| Medium | 90.24 | 2.25 | 31.00 | 69.00 |
| Large | 95.26 | .77 | 20.48 | 79.52 |
| Super | 92.19 | 1.25 | 23.08 | 76.92 |
| Farm supply | 88.00 | .61 | 30.80 | 69.20 |
| Mixed farm supply | 99.08 | — | 15.09 | 84.91 |
| Mixed marketing | 96.76 | — | 24.58 | 75.42 |
| Marketing | 88.44 | 3.33 | 18.37 | 81.63 |
| Anhydrous ammonia nurse tanks | | | | |
| Small | 59.59 | 2.00 | 61.21 | 38.79 |
| Medium | 61.25 | 2.25 | 64.82 | 35.18 |
| Large | 82.37 | 1.43 | 61.76 | 38.24 |
| Super | 96.17 | — | 61.59 | 38.41 |
| Farm supply | 68.74 | 1.23 | 59.78 | 40.22 |
| Mixed farm supply | 83.98 | 1.20 | 56.79 | 43.21 |
| Mixed marketing | 97.47 | .40 | 64.89 | 35.11 |
| Marketing | 96.42 | .77 | 66.22 | 33.78 |
| Anhydrous ammonia tool bars | | | | |
| Small | 52.03 | 2.00 | 25.78 | 74.22 |
| Medium | 52.20 | 1.46 | 22.66 | 77.34 |
| Large | 78.03 | 1.43 | 28.44 | 71.56 |
| Super | 98.51 | — | 25.02 | 74.98 |
| Farm supply | 61.50 | 1.00 | 35.99 | 64.01 |
| Mixed farm supply | 83.74 | 1.20 | 17.93 | 82.07 |
| Mixed marketing | 90.96 | .40 | 24.54 | 75.46 |
| Marketing | 82.69 | .52 | 20.36 | 79.64 |

— = No responses.

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