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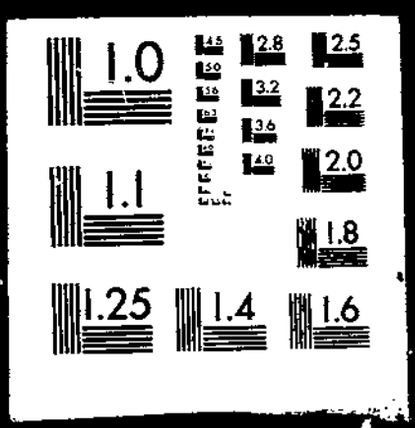
COOPERATIVE FARM FERTILIZER COSTS.

DONALD L. VOGELSANG

ECONOMICS, STATISTICS, AND COOPERATIVES SERVICE, WASHINGTON, DC.



U.S. DEPARTMENT OF COMMERCE
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(U.S.) Economics, Statistics, and Cooperatives Service, Washington, DC

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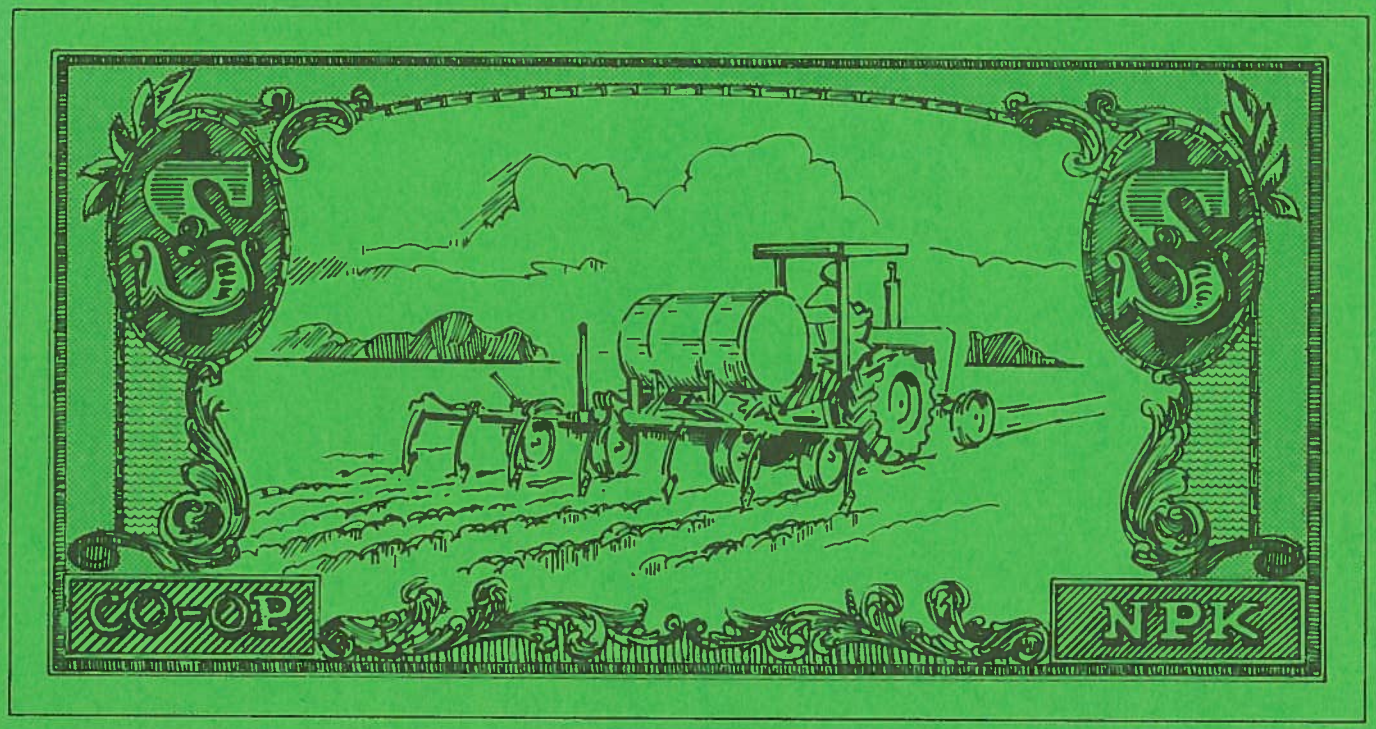

United States
Department of
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Economics,
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Farmer Cooperative
Research
Report No. 8

Preface

Cooperatives, like other businesses, have undergone dramatic changes in size, organizational structure, and operating characteristics. Congress, recognizing these developments, included funds in the 1977-78 budget of the Economics, Statistics, and Cooperatives Service "to study the trends and effectiveness of the cooperative movement and to assess the need for accelerating the promotion and development of cooperatives."

One project selected for study was the impact of cooperatives in the fertilizer industry. How and in what ways do cooperatives benefit farmers? To what extent do they enhance competition within the fertilizer industry?

This report seeks to answer these and other questions. It covers the costs of fertilizers to farmers purchasing through cooperatives versus other firms in 1975, the latest year comparative data were available. Noncooperative data were obtained under contract from Doane Agricultural Services, Inc., St. Louis, Mo.

The other reports will cover comparisons of fertilizer services and effects of cooperatives on structure, production, and distribution costs in the nitrogen fertilizer industry.

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Farmers buying plant food from cooperatives paid 8 percent less per ton than those buying from other firms. On the average, farmers paid $361 per ton of nutrient from cooperatives in 1975, compared with the $392 they paid noncooperatives. This price differential of $31 a ton saved cooperative patrons close to $200 million that year. These savings did not include patronage refunds declared to farmers on their 1975 purchases or any potential savings from restraints the cooperative presence may have had on the overall market. Nor did the study include data on differences, if any, in fertilizer services provided by the cooperatives versus noncooperatives.

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Highlights

Farmer cooperatives departed from their long-established practice of pricing fertilizer "at the going market" in 1975. A nationwide survey indicated that farmers buying plant food from cooperatives paid 8 percent less per ton than those buying from other firms. Cooperatives apparently did not follow the market as far as they might have during the period of large price increases that continued into the spring of 1975.

On average, farmers paid $361 per ton of nutrient from cooperatives in 1975, compared with the $392 they paid noncooperatives. This price differential of $31 a ton saved cooperative patrons close to $200 million that year.

These savings did not include patronage refunds declared to farmers on their 1975 purchases or any potential savings from restraints the cooperative presence may have had on the overall market. Nor did the study include data on differences, if any, in fertilizer services provided by cooperatives versus noncooperatives.

Cooperative fertilizers were especially good buys in an area extending from Texas northward to North Dakota, and eastward through Indiana, Pennsylvania and into the New England States. More explicitly, cooperatives provided lower costs per ton of plant food in four out of five regions, as follows:

Region	*Percent Lower*
North Atlantic	9
East North Central	7
East South Central★	7
West North Central	6
West South Central	17

★Result was not statistically significant because of excessive variances.

Similar differences were observed nationally for the following product groups:

Product group	*Percent Lower*
Straight nitrogen products	6
N-P materials	12
Dry blends	6
Dry mixtures	6

Sixteen of the foregoing 20 region-product comparisons (5 regions times 4 products) showed differentials favoring cooperatives. Only 4 of the 16 were statistically significant, but other data helped affect findings in favor of cooperatives. Moreover, the cooperative cost to farmers was not significantly higher than the noncooperative cost in any of the 20 comparisons.

The source of differential in 1975 probably has both short-term and long-term bases. In the short term, the cooperative system apparently passed some of its savings to farmers as price concessions at time of sale instead of patronage refunds at yearend. This action spared cooperative patrons some anxiety caused by rapidly rising nutrient prices, fertilizer bills, and financing costs.

In a long-term context, this differential may reflect a difference in cooperative and noncooperative marketing strategies. It definitely reflects a difference in the product mix. In 1975 the relatively low cost, N-P materials and bulk blends comprised 41 percent of the cooperative plant food tonnage whereas these products accounted for only 29 percent of the noncooperative tonnage.

Total 1975 fertilizer market to commercial farmers, based on the sample of farmers reporting in the study, was 13.9 million nutrient tons valued at $5.25 billion. Cooperatives supplied 46 percent of the total. No association was found between market shares and favorable cooperative cost differentials to farmers.

COOPERATIVE FARM FERTILIZER COSTS

Donald L. Vogelsang
Agricultural Economist

Farmer cooperatives have assumed a role of increasing importance in a growing fertilizer industry. From 1956 to 1966, fertilizer consumption increased 105 percent to 12.4 million tons of plant food (fig. 1). In the next decade, there was a 67-percent climb to 20.8 million tons.

Strong leadership was required to advance the role of farmer cooperatives in the fertilizer industry. The last two decades have been times of extreme change.

From 1956 to 1966, technology advanced spectacularly in the form of bulk blending, liquid mixing, and very large ammonia plants. During this period, the competitive structure also changed. Petrochemical companies became common names in the fertilizer market. In the meantime, some fertilizer companies that were established in one or two fertilizer ingredients expanded into two or more. Saskatchewan potash reserves were also tapped during this period.

The second decade experienced a continuing adoption of technology and an increase in bulk blending. Excessive capacity caused low fertilizer prices, with a profitless year in 1969. The result was an exodus by many petrochemical companies and consolidations by many that remained.

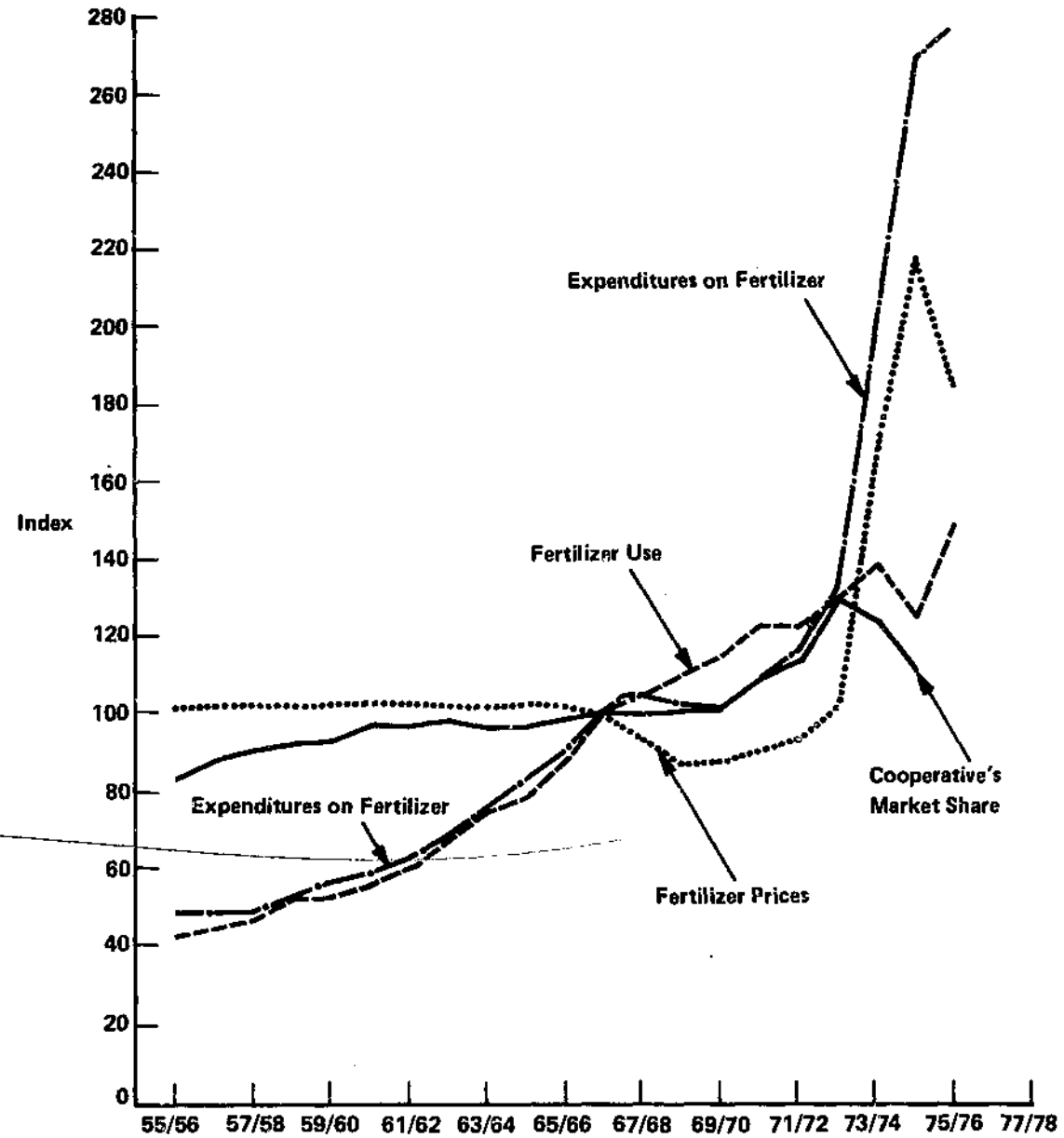
Then came the freeze on domestic fertilizer prices from August 1971 through October 1973 at about the same time that foreign demand was rising for U.S. grain. Consequently, grain prices skyrocketed, especially after massive Russian purchases in 1972/73.

During the same period foreign fertilizer prices rose sharply, resulting in an increase in U.S. exports. As a result of these events, U.S. fertilizer price trends reversed and rose quickly following decontrol and peaked during the spring of 1975.

Despite these influences, farmer cooperatives' share of the fertilizer market advanced. It climbed from 24 percent in 1955-56 to 28 percent in 1965-66 and then increased to an estimated 32 percent in 1974-75.

In addition to surmounting many changes and much tumult, farmer cooperatives have advanced their stake in a less than perfectly competitive fertilizer industry. This industry does not satisfy the conditions of a perfectly competitive mold. It does not have a sufficient number of participants to prevent individual buyers and sellers from influencing prices. Also, buyers don't know the market that well.

Figure 1--Trends in fertilizer market, 1955–56 to 1975–76 (1976 = 100)



While fertilizer-buying farmers are numerous, they deal with an industry supplied by a few. This structure provides basic suppliers with a peculiar type of market power. As Markham noted, in 1958 regarding the manufacturing-wholesaling sector:

"This power is derived from an assumed pattern of behavior among rivals when they are few in number. Each firm knowing beforehand that certain actions it may take will prompt its rivals to retaliate, will take only those actions that would leave it better off after its rivals have retaliated."[1]

Usually, this consideration sets a price level higher than necessary under a more competitive market structure.

Despite notable declines in concentration, a high proportion of basic fertilizer production remains under the control of relatively few companies. The importance of the top four producers in selected materials ranges from 25 percent to 64 percent (table 1).

Such control puts them in a position to enhance prices and influence selling practices. Markham noted, as late as the mid-1960's, even for anhydrous ammonia, "...that competition is still not sufficiently effective at the manufacturers' level to eliminate monopoly profits and to force producers to operate at optimum scale and output rates."[2]

Whether price enhancement by forces that control the market (oligopoly) within the primary material markets[3] generally is compounded further at the retail level is debatable. Markham has asserted that retail prices "are regulated by strong competitive forces"[4] and has support from Kentucky economists. They found that higher fertilizer prices were not associated with a lower number of outlets.[5]

Table 1—Trends in concentration of capacity in selected fertilizer products, percentage controlled by four largest firms, calendar years

Selected products	1950	1966	1976
		Percent	
Synthetic ammonia	[1,2]63	26	25
Phosphate rock	[2,3]70	--	50
Concentrated superphosphate	91	51	60
Potash	95	[4]55	64

[1]1951data.
[2]Percentage of shipments.
[3]Largest five firms in 1954.
[4]1965 data.
-- N/A

Sources: French, Charles E., and others. *Agricultural Cooperative Survival in a Changing Environment.* Purdue Univ. and U.S. Dept. Agri., Farmer Coop. Serv., p. 60, of manuscript. Gale, John F. "Note 3—Fertilizers." *Structure of Six Farm Input Industries.* ERS-357. U.S. Dept. Agr., Econ. Res. Serv., Jan. 1968, p. 31. Moore, John R., and Walsh, Richard G. *Market Structure of the Agricultural Industries: Some Case Studies.* Iowa State Univ. Press, Ames, Iowa, 1966, p. 373.

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[1]Markham, Jesse W., The Fertilizer Industry—Study of an Imperfect Market. The Vanderbilt University Press, Nashville, Tenn., 1958. p. 182.

[2]Author of chapter 14 in Moore, John R., and Walsh, Richard G., Market Structure of The Agricultural Industries: Some Case Studies, The Iowa State University Press, Ames, 1966, p. 374.

[3]Markham, *op. cit.*, p. 159.

[4]*Loc. cit.*

[5]Berry, James E., Smith, Eldon D., and Rudd, Robert W., Selected Factors Affecting the Price of Fertilizer in Kentucky Retail Markets. University of Kentucky, Lexington, June 1965, p. 23.

Nebraska economists have found, however, that the average fertilizer buyer faced an oligopolistic structure in 1961. While he faced competition from only two of three fertilizer outlets the average dealer supplied 450 buyers.[6] Moreover, dealers followed the oligopolistic practice of engaging mainly in nonprice competition.[7] Peterson and Spielmann made a similar observation about the western fertilizer market. They said, "Market conduct, as market structure, exibits imperfectly competitive characteristics ..."[8] despite a general satisfaction with dealer products and prices.[9] Lavern Maxwell, meanwhile, took exception to part of this conclusion and observed that "Eastern Colorado fertilizer dealers had not, and probably would not, become monopolistic ..."[10] Erlewine and Walsh differed with Maxwell's conclusions. They stated that most Nebraska farmers, "...simply have no choice between pricing methods."[11]

Market Situation

At least one concern is raised in a market situation where oligopolistic structure predominates. This concern takes the form of the following question, "How much, if any, have cooperatives saved their patrons from oligopolistic price enhancement?"

Presently, the answer to this question is inconclusive. Evidence indicates that some cooperatives either have or are believed to have benefitted their patrons. For example, at the retail level, cooperatives saved Kentucky patrons $1.60 per ton in 1963, including patronage dividends.[12] A little later, other researchers found that 37 percent of the farmers responding thought that cooperative fertilizer prices were lower than prevailing market prices.[13]

These actions are consistent with cooperative philosophy and the observation by Nebraska economists in 1962 that, "patrons of a large efficient cooperative (retail) are in a position to demand quantity discount price leadership. ..."[14] These authors found twice the number of purchases from cooperatives bore quantity discounts as those from non-cooperative dealers.

At the manufacturer-wholesaler level, some regional supply cooperatives reported selling fertilizer for prices below competitors in 1975. Selected excerpts from annual reports include the following:

"Farmland's fertilizer prices benefitted farmers as its production was generally sold at prices lower than competitors."[15]

"Fertilizer prices around the world had already skyrocketed to unprecedented heights as our fiscal year began. During this period Valley Nitrogen held a firm line by

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[6]Erlewine, Keith R., and Walsh, Richard G., Changes in Market Structure and Costs of Farm Supply Retailing, Agricultural Economics Report No 28, University of Nebraska, Lincoln, December 1962, pp. 8-9.

[7]*Ibid.*, p. 40.

[8]Peterson, H. D., and Spielmann, Heinz, "Structure-Conduct Dimensions of the Fertilizer Market in the Western Region (Wyoming and West)." Printed by the University of Nebraska from a paper prepared for Farm Supply Industry Seminar in Denver, June 1974, p. 48.

[9]*Ibid.*, p. 49.

[10]*Ibid.*, p. 54.

[11]Erlewine and Walsh, *op. cit.*, p. 42.

[12]Berry, Smith, and Rudd, *op. cit.*, p. 26.

[13]Peterson and Spielmann, *op. cit.*, p. 44.

[14]Erlewine and Walsh, *op. cit.*, p. 43.

[15]*1975 Annual Report*, Farmland Industries, Inc. (Year ending 8-31-75), p. 9.

maintaining prices at less than 50 percent of world prices and between 80 percent and 90 percent of average U.S. prices."[16]

Recently, the urgency has grown for answering the question about any savings on fertilizer purchases that cooperatives may have provided their patrons. Strong critical voices have been raised both in and out of the cooperative movement.

Within the cooperative movement, reports indicate that some patrons have become critical. Being both investor and buyer, they believe they can buy other brands of fertilizers cheaper than those of cooperatives. Some think that patronage refunds, especially the cash portion, are too small. Others question policies on equity revolvement.

Until the mid-1970's, main attacks on supply co-ops from outside the movement had been made indirectly. Either they were directed at marketing cooperatives or were broadly based and directed at all cooperatives.[17] The National Tax Equality Association, for example, since the 1940's, has worked to repeal the differential tax treatment of cooperatives. Currently, challenges focus on the antitrust immunity of marketing cooperatives found in the basic law resulting from the Capper-Volstead Act of 1922.

Late in 1976, however, farmer-owned supply cooperatives began to receive pointed attacks. The National Fertilizer Solutions Association publicly opposed the role of regional manufacturing cooperatives in the fertilizer industry. Moreover, noncooperative managements have been making periodic studies of the status and trends of farmer cooperatives in manufacturing and distribution of plant food.

Thus there is a need to study the impact of fertilizer cooperatives to provide more definitive information on how they may have benefitted American farmers.

Objectives

This study was initiated to develop preliminary observations regarding the enhancement of competition within the fertilizer market by cooperatives. More specific study objectives were:

1. To learn whether cooperative-supplied fertilizers cost less (were priced lower) than noncooperative fertilizers, excluding patronage refunds.
2. To detect the effect of geography, product, and cooperative market penetration on any cost differentials that might exist.

Scope Of The Study

To accomplish these objectives required cooperative and noncooperative data by regions and product groups. It required that these data include:

— Plant nutrient tonnage
— Total fertilizer costs
— Per ton costs of fertilizer nutrients

These data were developed for the United States, that is, its 48 contiguous States

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[16]1975 Annual Report. Valley Nitrogen Producers, Inc. (Year ending 9/30/75), p. 7.

[17]Two of the most publicized attacks are: Kravitz, Linda, "Who's Minding the Co-ops?", Agribusiness Accountability Project, Washington, D.C., March 1974; and a lengthy article in *Business Week*. "The Billion Dollar Farm Co-ops Nobody Knows," Feb. 7, 1977, pp. 53-64.

and for seven geographical regions as shown in figure 2. Data are estimates of fertilizer purchases by commercial farmers[18] during the 1974-75 fertilizer year ending June 30, 1975.[19]

Data generated included farmers' purchases of total primary plant nutrients from all fertilizers (table C-1) and five subgroups: liquid mixtures (table C-2), straight nitrogen (table C-3), N-P products (table C-4), dry blends (table C-5), and dry chemical mixtures (table C-6).

Three of these terms are defined as follows:

Plant Nutrients. The primary plant nutrient consumption includes nitrogen (N), phosphate (P_2O_5) and potash (K_2O).[20] It was determined by multiplying the analysis of each fertilizer against the total tonnage of product applied by farmers.

N-P Materials. All ammonium phosphates have been included in this category known as N-P materials. These grades are: 8-32-0, 10-20-0, 11-48-0, 11-55-0, 13-39-0, 16-20-0, 16-48-0, 18-46-0, 20-52-0, 21-53-0, 27-14-0, 29-14-0, and 30-10-0. Other grades containing a nitrogen-phosphate combination were included in mixtures.

Dry Blends. Blended fertilizer is considered "custom mixed" fertilizer. Farmers have great difficulty distinguishing between chemically mixed and blended fertilizers. Errors in this area were eliminated whenever detectable.

While attempting to utilize common terms used throughout the fertilizer industry, the foregoing terms may vary from those used in other government reports.

Methodology

Doane's Responsibility

Farmer Cooperative Service (FCS), which later became a part of ESCS, contracted with Doane Agricultural Service, Inc., St. Louis, Mo., to provide the information previously described. Doane was uniquely qualified to perform this task because it had annually sampled commercial farmers for several years regarding fertilizer purchases, including quantities, plant food nutrients, expenditures, and associated services.

In 1975, this survey involved a mailing to 10,356 and a response from 6,128. Since Doane had stored the results of its survey in a computerized data bank, it incurred relatively little trouble in helping fulfill study objectives.

Doane also calculated the "standard error" for each mean and the differences in the means of cooperative and noncooperative fertilizer costs. It made these calculations using a computer program developed by the Statistical Laboratory at Iowa State University. (See appendix A).[21]

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[18]Commercial farmers were those grossing $2,500 or more from farm enterprises.

[19]Unless indicated otherwise, all subsequent references will be to a fertilizer year ending June 30.

[20]All references to follow are to be in tons of plant nutrient unless stated differently.

[21]Appendix A provides further details on the Doane survey.

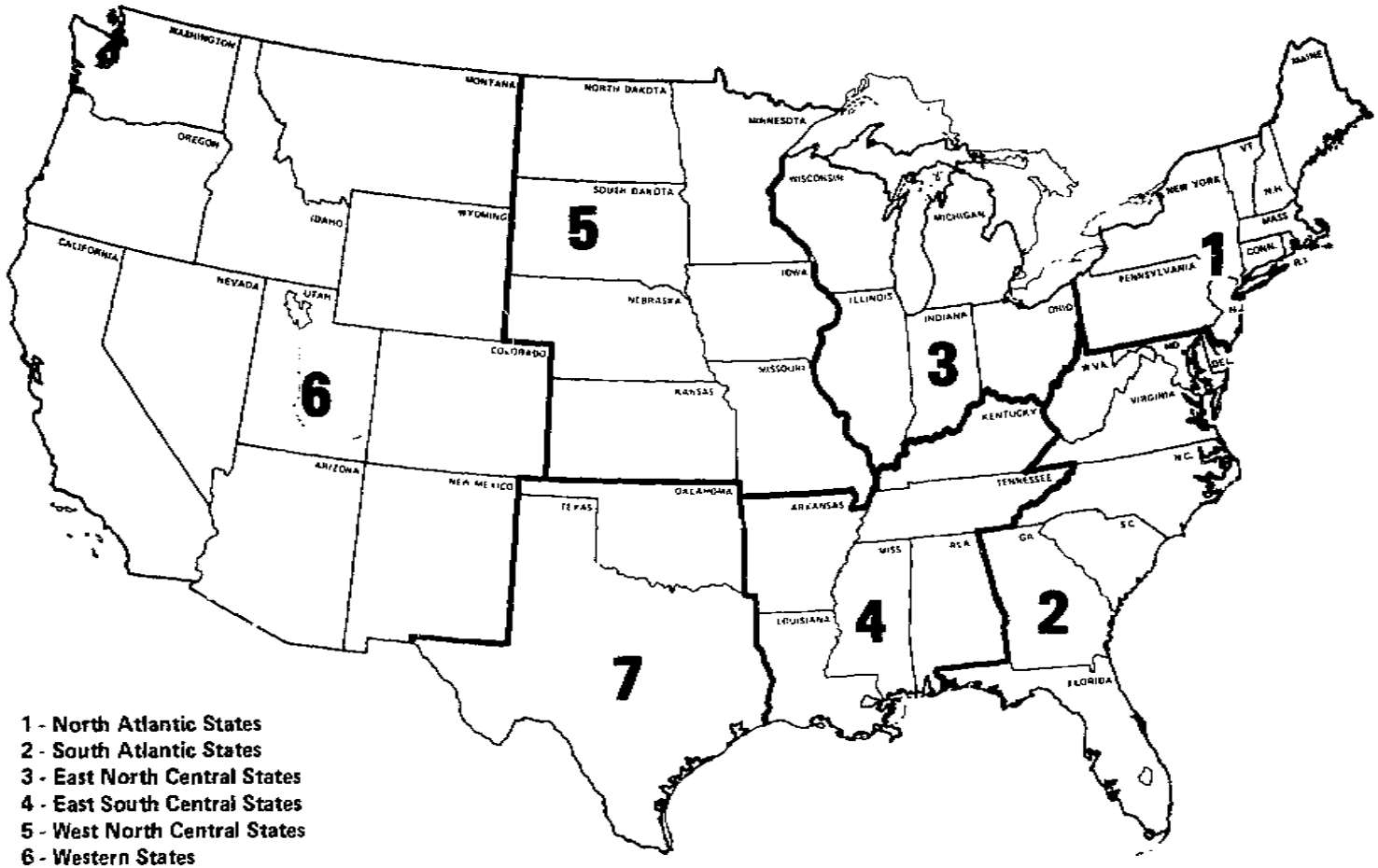

Figure 2--Doane countrywide farm panel regions

ESCS's Evaluation

ESCS evaluated the accuracy of each predicted average cost (PAC) of fertilizer. It did this by comparing each to a comparable weighted average cost (WAC) of fertilizer made possible because Doane developed data through two independent approaches. (See appendix B).

This analysis indicated the acceptablility of making both national and regional cooperative-noncooperative comparisons of fertilizer costs of total plant nutrients, and also similar cost comparisons for each product group at the national level.

This analysis suggested that selected product groups and regions be eliminated from a co-op and nonco-op comparison of fertilizer costs because of internal inconsistencies of estimates. These products and regions are:

Products	Regions	Tonnage of plant foods
		Thousands
Liquid mixtures	1	25
	4	26
	6	54
Straight nitrogen	1	68
N-P products	1	6
	2	15
	4	4
Dry blends	none	0
Dry chemical mixes	2	827
Total		1,025

Note: See appendix table B-4 for more details.

Findings

The study indicated that commercial farmers bought 13.9 million tons of plant food or nutrients in the fertilizer year ended June 30, 1975. Of this tonnage, cooperatives supplied 6.4 million tons, or 46 percent of the total.

The cooperative portion had an 80/20 ratio favoring fertilizer materials including dry blends) over mixtures, while the noncooperative had a ratio of 70/30 (table 2).

These purchases represented a total expenditure of $5.25 billion for commercial plant food sales. In other words, commercial farmers paid an average of $379 per ton of plant food in the 1975 fertilizer year.

Foregoing estimates compare to total farm expenditures of $5.95 billion and total U.S. fertilizer consumption of 17.6 million nutrient tons as reported by agencies within the U.S. Department of Agriculture.[22] These data indicated an average cost of $339 per ton.

[22]Commercial Fertilizers.

Table 2—Product mixes of cooperatives and noncooperatives in the fertilizer market, 1975[1]

Product groups	Cooperatives		Noncooperatives	
	1,000 tons	*Percent*	*1,000 tons*	*Percent*
Straight nitrogen	2,158	34.0	2,591	34.5
N-P products	422	6.6	302	4.0
Dry blends	2,162	34.0	1,873	25.0
Dry chemical mixtures[2]	1,098	17.3	1,705	22.7
Liquid mixtures[2]	145	2.2	714	9.5
Other products	372	5.9	321	4.3
Total	6,357	100.0	7,506	100.0

[1]Tons of plant food nutrients.
[2]Mixtures constituted 19.5 percent of cooperatives' volume and 32.2 percent of noncooperatives' volume.

National Difference in Average Fertilizer Costs

Findings from this study showed that the average fertilizer cost at cooperatives was $361 per ton, compared with $392 per ton at noncooperatives in 1975, a difference of 8 percent.

These data suggest that in a year of rising fertilizer prices, cooperatives restrained themselves from following the market. Apparently cooperative management felt that patron well-being called for such restraint. This means that fertilizer-supplying cooperatives generally departed somewhat from the tradition of "pricing at the market."

That policy saved patrons at least $198 million on fertilizer purchases in 1975. This estimate includes only the $31-per-ton savings on purchase price. It is difficult to measure what the cost might have been without a strong cooperative presence in the industry.

The extent to which 1975 was an unusual year is not fully known. Perhaps most of the cost differential to the patrons of farmer-owned cooperatives was only a shortrun phenomenon. Perhaps most of this differential was caused by market conditions pushing prices to abnormal heights unwarranted by production costs. Regardless, profits were enhanced, or in the case of cooperatives, saving were increased.

As noted earlier, some regional and interregional cooperatives seemingly chose to pass a portion of these savings to their farmer patrons at time of sale. Perhaps this action resulted from pressure by patron owners who were bearing a growing financial burden caused by abnormally high and advancing fertilizer prices. In any case this pricing strategy provided farmers with some immediate relief, with more to follow at year's end in the form of patronage refunds.

The total savings on fertilizer purchased by cooperative patrons cannot be determined because the level of patronage refunds is unknown. Some appreciation of what they were can be gained, however, by noting that CF Industries paid a cash patronage refund of about $28.30 per ton of nutrient and a noncash patronage refund of $17, or

a total refund of about $45.30 per nutrient ton.[23] This refund was paid to member regional cooperatives who passed along an unknown portion to their farmer patrons, if direct members, or to their member locals who in turn made distribution to their farmers.

If the $31-per-ton recorded savings is more than a shortrun phenomenon, an important part of these savings may have resulted from more than a difference in cooperative and noncooperative pricing strategies.

In a longer-run context, such savings might flow from a difference in the fertilizer package being marketed. Unlikely as it might seem, cooperatives could have charged lower prices because they provided fewer fertilizer-related services than noncooperatives. Cooperatives could have offered relatively fewer crop advisories, product deliveries, fertilizer applications, and purchase financings.

It is more likely, however, that 1975 documented one longrun source that accounts for at least a small portion of the $31 differential. That is the difference between cooperatives and noncooperatives in their product mixes, with cooperatives selling relatively more low-priced products, that is, N-P materials and bulk blends. The results are depicted in table 3.

Regardless of the source of the $31 cost differential that favored cooperatives in 1975, this differential was well supported by data generated from the study. They disclosed only one average out of 35 product-region comparisons (five products in seven regions) where the per-ton expenditure on cooperative fertilizers may have been significantly higher than noncooperative fertilizer. Even this difference, however, may be questionable as noted earlier. Consequently, in three-quarters of the product-region comparisons (26 out of 35), the average cost of cooperative fertilizers was lowest.

Narrowing the analysis to 20 product-region comparisons in the 5 regions with most reliable data yields 16 with a cost differential favoring cooperatives in 1975. (See table 4.)

Regional Variations in Cost Differences

The study revealed that fertilizers supplied by cooperatives carried a significantly lower per-ton cost[24] to farmers than the fertilizers supplied by noncooperatives in at least four out of seven regions in 1975 (table 5). This area included the central and northeastern parts of the United States (fig. 3). It accounted for two-thirds of all fertilizer purchases.

Unfortunately, findings were least reliable in Regions 2 and 6. Eliminating these regions, therefore, increases the relative importance of those regions with lower cooperative costs. It drives the ratio of regions to four of five and the proportion of fertilizer to 87 percent.

The significant regional cooperative-noncooperative cost difference was generally

[23] *CF Industries, Inc., Annual Report 1975* (Year ending 6/30/75), p. 5A. Total patronage refunds generated by this interregional producer of fertilizers alone totaled $133.3 million.

[24] Cost is the preferred term because farmers reported their total expenditures for each type of fertilizer, not the prices per ton they paid. However, the derived cost per ton includes an unknown amount of variation in the number and magnitude of services accompanying each average.

Table 3—Analysis of variations in cooperative versus noncooperative fertilizer costs per ton due to type of product mixes, 1975

Source and type of fertilizers	Farmer cost	Share of business	Weighted share of average cost	Total cost[1]
	Dollars	*Percent*	*Dollars*	
Noncooperative-supplied fertilizers:				
N-P materials and bulk blends	374	29	108	
Other products	412	71	293	401
Cooperative-supplied fertilizers:				
N-P materials and bulk blends	350	41	143	
Other products	386	59	227	370
Difference in cost to farmers in favor of cooperatives				31

[1]Group weighting causes resultant averages to rise $9 per ton above the more reliable estimates reported earlier.

Table 4—Comparisons of 1975 fertilizer costs from cooperatives and noncooperatives in five regions for four major types of products

Region	Regional code[1]	Co-op lower than nonco-op				
		Nitrogen products	N-P materials	Dry blends	Dry mixtures	Total
North Atlantic	1	-	[2]X	X	X	3
East North Central	3	X	X	X	X	4
East South Central	4	X	-	X	X	3
West North Central	5	X	-	X	-	2
West South Central	7	[2]X	[2]X	X	[2]X	4
Total[3]	--	4	3	5	4	16

Region	Regional code[1]	Co-op higher than nonco-op				
		Nitrogen products	N-P materials	Dry blends	Dry mixtures	Total
North Atlantic	1	X	-	-	-	1
East North Central	3	-	-	-	-	0
East South Central	4	-	X	-	-	1
West North Central	5	-	X	-	X	2
West South Central	7	-	-	-	-	0
Total[3]	--	1	2	0	1	4

[1]The following regions are excluded: South Atlantic (2) 2nd Western (6).
[2]Statistically significant.
[3]Further details given in table B-3. Above comparisons exclude liquid mixtures, and the South Atlantic and Western regions because of lower degree of accuracy in their data.

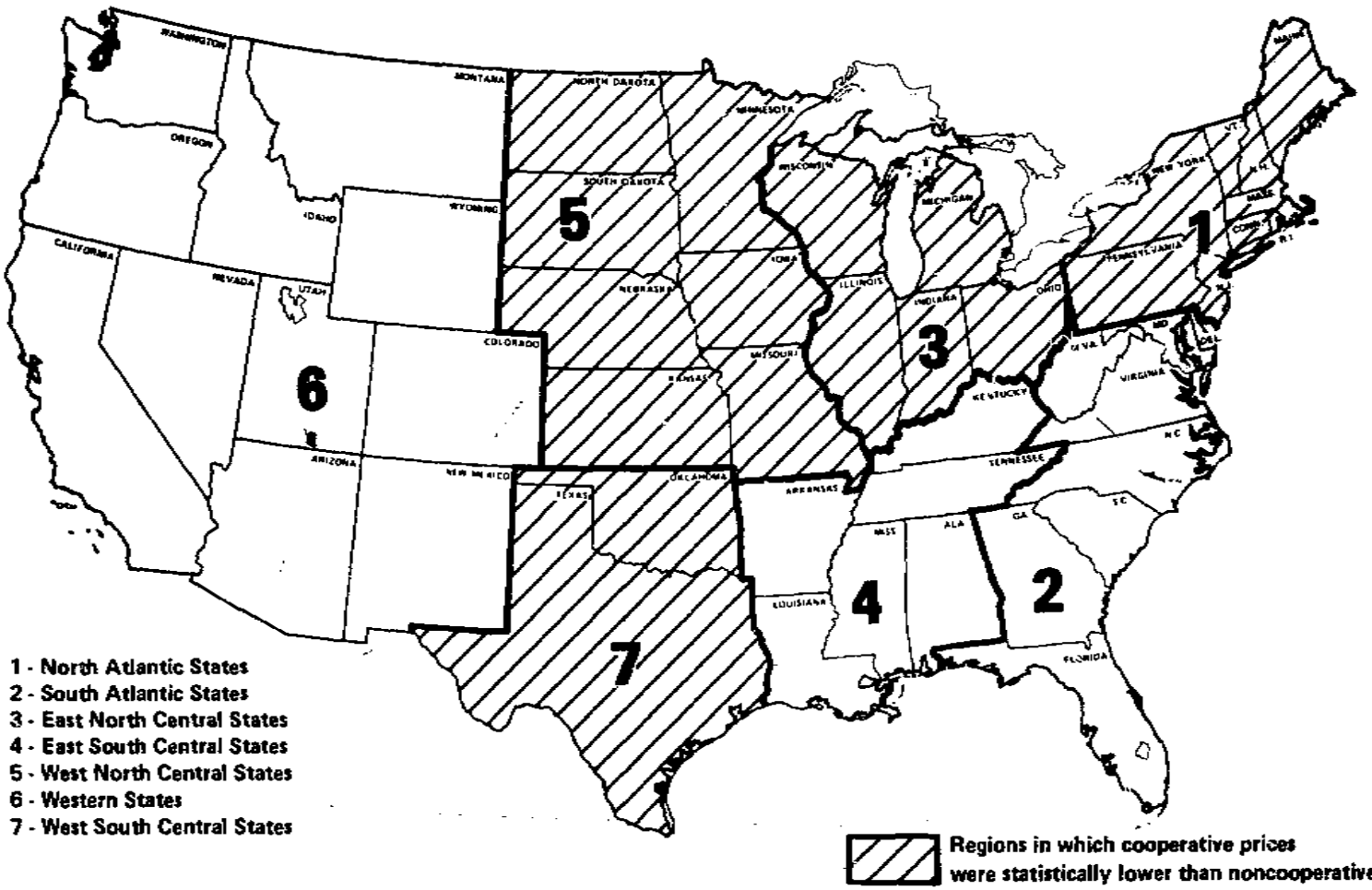

Figure 3--Area of significantly lower cooperative fertilizer costs per ton, Doane regions, 1975

extended to product groups within one region only. Again, it was Region 7, with the following differences registered:

Product	Cost per ton of nutrients		Difference	
	Cooperative	Noncooperative	Amount	Percent
	-----Dollars-----			
Liquid mixtures	432	497	65	-13
Straight nitrogen	347	415	68	[1]-16
N-P materials	359	453	94	[1]-21
Dry Blends	355	403	48	-12
Dry chemical mixes	370	438	68	[1]-16
All products	358	431	73	-17

[1]Significantly different at the 5 percent level of confidence.

Only one other area, Region 1, registered a significantly lower cooperative-per-ton expenditure on a product group. The group was N-P materials.

Product Variations in Cost Difference

Within regions, only four fertilizer groups carried significantly lower cooperative costs. Moreover, only one group, liquid mixtures in Region 2, may have carried a higher cooperative price. There, a price of $591 per ton was $167, or 39 percent, higher than competition (table C-2). This difference should be accepted with caution, however, because of problems with data (see appendix B).

Thus, among regional product groups, cooperatives generally seem to have followed their traditional practice of pricing at the market level. Nevertheless, significant differences probably exist on specific products and from specific suppliers.

Aggregations of all regions do yield significant results. At the national level cooperative costs per ton were lower than competitor costs for all product groups except liquid mixtures (table 6). Actually, significantly lower cooperative prices may have been more widespread among product groups than indicated previously. Again, data problems may have distorted results (appendix B).

Variation According to Cooperative Share of Market

A great variation in cooperative market share existed among regions and products. While the overall average U.S. market share was 46 percent, the share among products varied from 17 percent for liquid mixtures to 58 percent for N-P materials (table 7).

Geographically, the cooperatives' share of nutrient consumption ranged from a low of 30 percent in Region 1, the South Atlantic States, to a high of 59 percent in Region 5, the West North Central States.

Region 5 attained this position by having the largest share in three out of the five product groups, namely, nitrogen materials, N-P products, and dry blends. This region's 77 percent share of N-P products was the largest for any product group in any region.

Table 5—Regional differences in cooperative and noncooperative fertilizer costs per ton of nutrient, 1975

Region	Cooperatives	Non-cooperatives	Difference[1,2,3]	
	Dollars			*Percent*
North Atlantic	383	421	-38	-9
South Atlantic	400	407	[4]-7	-2
East North Central	336	363	-27	-7
East South Central	347	373	-26	-7
West North Central	352	373	-21	-6
Western	460	464	[4]-4	-1
South North Central	358	431	-73	-17
U.S. average	361	392	-31	-8

[1]Amount by which cooperative cost is lower.
[2]Percent of noncooperative cost.
[3]Unless indicated otherwise, differences are meaningful to the 5 percent level of confidence. See table B-3 for details.
[4]The level of this difference is doubtful because of possible data errors (see appendix B).

Table 6—National cost differences in cooperative and noncooperative fertilizer costs per ton of nutrient, 1975

Region	Cooperatives	Non-cooperatives	Difference[1]	
	Dollars			*Percent*
Liquid mixtures	475	469	6	[2]+1
Straight nitrogen products	390	413	-23	-6
N-P materials	377	427	-50	-12
Dry blends	344	365	-21	-6
Dry mixture	364	385	-21	-6
All product average	361	392	-31	-8

[1]Except as indicated, all differences are statistically significant at the 5-percent confidence level.
[2]Not statistically significant.

Table 7—Cooperative share of farm fertilizer market (nutrient tons purchased), by region and product group, 1975

Region	All fert-lizers	Straight nitrogen materials	N-P mate-rials	Dry blends	Dry mix-tures	Liquid mix-tures
	Percent					
North Atlantic	47	26	33	44	60	4
South Atlantic	30	36	73	37	24	9
East North Central	42	37	52	50	34	16
East South Central	55	56	50	56	56	8
West North Central	59	58	77	64	57	21
Western	38	37	41	46	29	30
West South Central	31	33	35	40	23	19
U.S. average	46	45	58	54	39	17

Region 1—North Atlantic States—had the largest market share (60 percent) in dry mixtures, while Region 6—Western States—had the largest share (30 percent) in liquid mixtures.

The wide variance in market share raises the question of whether a relationship might exist between this factor and the cost differential favoring fertilizers supplied by cooperatives. Does this differential widen as cooperatives increase their market penetration and reflect economies of size?

While this hypothesis may or may not be true, it was not substantiated by an extensive series of regression analyses of data contained in this study. However, there is a question whether data from this study were inadequate to fully test the hypothesis. Perhaps they were too highly aggregated to develop a correlation between market share and the cooperative price differential.

Whatever the reason, the highest "r" value to be calculated was 0.35 (appendix B). This means that market share explained only 12 percent of the variation in difference in the farmer cost of cooperative and noncooperative fertilizers per ton of nutrient.

Recommendations

This report containing new information about cooperative involvement and marketing practices within the fertilizer industry should be viewed as preliminary and considered with reservations by cooperative and other industry leaders.

Results about a cooperative price differential in the 1974-75 fertilizer year should be used carefully. While quality of product was taken into account in the costs which were computed on a nutrient ton basis, the package of management and financial services accompanying each reported cost or price is unknown and might still explain an important part of this differential.

Additional research, therefore, should be undertaken to determine the extent of fertilizer services provided and the amount included in the reported fertilizer purchases from cooperatives versus noncooperatives.

Further research should determine whether differences exist in the nutrient content of fertilizer purchases, and if differences do exist, learn in what products and regions they occur.

Additional research, also, should be inaugurated to learn the nature of the cooperative price differential and market penetration since 1975. Quite possibly, the cooperative price advantage in fertilizers has disappeared as prices have moderated. If not, the differential may have shifted geographically and according to product. If such work is undertaken, it should complement the work of this study and increase its definitiveness by reducing region size and increasing the number of product groups. This approach might possibly define results more meaningfully.

The full differential which cooperatives had in 1975 is unknown until the amount of their patronage refunds is measured. Another phase of this project should take this measurement.

Finally, steps should be taken to resolve the divergence in market share reported in this study and the lower share documented by ESCS.

Appendix A - Doane's Methodology

Data for this study were obtained from a questionnaire Doane Agricultural Service mailed to farmers participating in its Countrywide Farm Panel. Farmers on the panel had agreed to supply the data requested. Questionnaires were mailed to 10,356 members with an approximate regional breakdown as follows:

Region 1	600	Region 5	3,100
Region 2	1,100	Region 6	1,000
Region 3	2,200	Region 7	1,200
Region 4	1,200		

Each State panel in Ohio, Indiana, Illinois, Iowa, Wisconsin, Minnesota, Missouri, and Nebraska has a sample of almost 500 farmers.

Farmers are selected for the Doane Countrywide Farm Panels based on their geographic location and characteristics describing their farming operation such as farm size and gross income. The panels are purposely designed to include a disproportionate number of large farms. This reflects the greater buying power of larger farms. In other words, panels members in each geographic region are stratified by five acreage groups of farms within each of five income classes.

A total of 6,128 farmers completed and returned their questionnaires, a 60 percent response. This response is summarized from table A-1 as follows:

Region	*Respondents*
1. North Atlantic	293
2. South Atlantic	586
3. East North Central	1,359
4. East South Central	665
5. West North Central	1,935
6. Western	595
7. West South Central	695
Total U.S.	6,128

Farmers were asked to record all purchases and application of fertilizer from July 1, 1974, through June 30, 1975, and their responses were edited and coded prior to key-punching and computer processing.

Fertilizer Consumption Estimates

Data received from the Panel were "expanded" to reflect the market for the entire population. Expansion factors were applied to answers received from farmers within each of the data cells in table A-1. Expansion factors equal the respective ratio for the number of respondents within each cell to the respective corresponding population for each cell.

Table A-1—Persons responding to annual fertilizer study, 1975

Region and acreageper per farm	Farm economic class					
	I	II	III	IV	V	Total
	Number					
Region 1:						
0-139	17	15	10	7	12	61
140-219	16	17	9	5	4	51
220-499	97	21	10	3	1	132
500-999	41	0	1	1	0	43
1,000 or more	5	0	0	1	0	6
Total	176	53	30	17	17	293
Region 2:						
0-139	21	28	29	39	29	146
140-219	29	27	15	19	7	97
220-499	96	34	19	14	3	166
500-999	85	12	15	2	1	115
1,000 or more	57	2	3	0	0	62
Total	288	103	81	74	40	586
Region 3:						
0-139	13	31	64	41	26	175
140-219	60	111	59	19	7	256
220-499	434	115	35	10	2	596
500-999	256	9	2	0	0	267
1,000 or more	63	2	0	0	0	65
Total	826	268	160	70	35	1,359
Region 4:						
0-139	5	10	38	43	45	141
140-219	8	24	31	25	11	99
220-499	85	54	51	12	3	205
500-999	96	16	12	2	0	126
1,000 or more	88	5	1	0	0	94
Total	282	109	133	82	59	665
Region 5:						
0-139	11	12	27	17	14	81
140-219	59	87	33	15	3	197
220-499	518	143	75	25	3	764
500-999	400	83	16	7	1	507
1,000 or more	342	37	5	2	0	386
Total	1,330	362	156	66	21	1,935
Region 6:						
0-139	31	24	16	11	9	91
140-219	29	11	2	6	4	52
220-499	85	10	7	3	4	109
500-999	52	10	7	2	1	72
1,000 or more	221	38	8	2	2	271
Total	418	93	40	24	20	595
Region 7:						
0-139	3	3	8	15	25	54
140-219	5	16	16	17	10	64
220-499	41	36	52	20	13	162

(Continued)

Table A-1—Persons responding to annual fertilizer study, 1975—*continued*

Region and acreage per farm	Farm economic class					
	I	II	III	IV	V	Total
	Number					
500-999	106	39	20	12	2	179
1,000 or more	187	30	16	2	1	236
Total	342	124	112	66	51	695
U.S. Total						
0-139	101	123	192	173	160	749
140-219	206	293	165	106	46	816
220-499	1,356	413	249	87	29	2,134
500-999	1,036	169	72	26	5	1,309
1,000 or more	963	114	33	7	3	1,120
Total	3,662	1,112	712	399	243	6,128

Population estimates are based on the 1969 Census of Agriculture updated to 1975 through an analysis of trends occurring in agriculture.

All information that relates to tonnage and expenditures for each crop were further adjusted according to the ratio between: (1) Doane estimates of acreage for each crop produced by commercial farmers, and (2) expanded acres of individual crops obtained from the Panel. The following formula illustrates the method used to develop estimates for tonnage expenditure and fertilizer application shown in the report:

$$\text{Fertilizer Application Data} \times \frac{\text{Doane Estimate of Acres (USDA Based)}}{\text{Expanded Acres}} = \frac{\text{Expanded}}{\text{Estimate}}$$

Resultant expansions are presented in table C-1 thru C-6

Cost Per Ton Estimates and Standard Error

Doane used a second computer program developed by Iowa State University to establish cooperative and noncooperative fertilizer cost per nutrient ton. The program is called Super Carp (Cluster Analysis and Regression Program) and is designed for the analysis of survey data with sample sizes up to 20,000 observations. It is written to analyze multistage and stratified samples. It operates independently from the program previously referenced for projecting total purchases.

The Super Carp program was used also to calculate the standard error or standard deviation of predicted mean fertilizer prices ($\hat{R}$) and mean difference in such prices ($\hat{R}_d$). More explicitly, SE ($\hat{R}_d$) is defined as the standard error of the predicted difference ($\hat{R}_d$) in average cost per nutrient ton (co-op minus nonco-op). SE ($\hat{R}_d$) also equals the $\sqrt{\text{Var}(\hat{R}_d)}$ with Var meaning the variance of ($\hat{R}_d$).

Both the means and the standard errors were calculated from data on individual purchases. Doane's questionnaire allowed space for nine analyses, but Super Carp will permit a maximum average of about three per fertilizer grade. Some farmers reported no purchases of a single grade, while others reported multiple purchases, such as those from different suppliers and at different times of the year.

Appendix B - ESCS Evaluations

Internal Consistency

ESCS examined the internal consistency of data underlying each cost[1] of selected fertilizer products as provided by the Doane Agricultural Service for this study. This analysis was applied to data from each of Doane's regions.

Because of internal inconsistency, the overall cooperative-noncooperative price comparison became tenuous in Regions 2 and 6. Internal inconsistencies exist on enough product groups in Region 2 to exceed one-third of the noncooperative nutrient tonnage (table B-1). For this reason some observations exclude Region 2.

The overall cooperative-noncooperative differential is considered tenuous in Region 6 because the accuracy index exceeds 10 (table B-2) and the calculated "t" value falls within the critical area at a 5-percent level of confidence. Region 6 is sometimes excluded from comparison because of the foregoing reason. Note that Region 1, with an accuracy index of 15.7, is acceptable because the calculated "t" value falls outside the critical area (table B-3).

Product groups with internal inconsistencies are called "problem products" and their importance is given in table B-1. These products are identified in table B-4.

"Problem products" are those with over a 2-percent difference in average cost (DAC) between the predicted average cost per ton of fertilizer nutrients (PAC) and the weighted average cost per ton of fertilizer (WAC). This condition holds at the regional level, with a product qualifying if the DAC for either cooperative or noncooperative sales exceeds 2 percent.[2]

A product was classified as a problem, also, if the difference between the cooperative DAC and noncooperative DAC exceeded 2 percent of the cooperatives' WAC. This comparison is appropriate because of some opposite signs on either the cooperative and noncooperative DAC. This criterion qualified N-P nutrients in Region 2. There the cooperative DAC, on N-P nutrients, equals -1.43 percent while a comparable figure for noncooperative is 0.89 percent. Thus, the absolute difference is 2.3 percent.

Calculation of DAC's was possible because Doane used a different procedure for calculating PAC's than for the data it provided ESCS to calculate WAC's. The PAC's are found in column 4 of tables 1 thru 6 in Appendix C. WAC's equal total dollars spent (column 2) divided by nutrient tons (column 1). For example, the WAC for all nutrients sold by cooperatives in the United States equals $2,299,902,000 for the 6,357,000 tons. The result is $362 per ton or only $1 more than the PAC (table B-4).

Note that the average national cost on all "problem products" is $414 per ton for cooperatives and $416 for noncooperatives, both of which are higher than the respective overall averages. Such is generally true for all regions, except Region 2.

As observed under Findings section, eliminating Regions 2 and 6 means that cooperatives' fertilizer costs were lowest in four of the remaining five regions. This elimination does not seem to significantly affect the difference between cooperative and noncooperative costs.

[1]Cost refers to the expenditure by farmers.

[2]Some of the excessive differences probably resulted from rounding errors. This problem is especially noticeable in regions with small markets. The difference in Region 2 (for dry chemical mixtures) is more difficult to explain, but seems to indicate an error either in Doane's data or its computations.

Table B-1—Problem fertilizers by type of outlet: Volume and cost comparisons with all fertilizers, by region, 1975[1]

Region and fertilizers[2]	Cooperatives		Noncooperatives		Total volume
	1,000 tons	*1,000* dollars	*1,000* tons	*1,000* dollars	*1,000* tons
Region 1:					
Problem products[1]	21	11,327	78	39,223	99
Other products	228	84,410	203	79,292	431
Total	249	95,737	281	118,515	530
Problem fertilizers as a percentage of total	8	12	28	33	19
Region 2:					
Problem products[1]	212	80,700	630	247,265	842
Other products	348	143,962	670	283,191	1,018
Total	560	224,662	1,300	530,456	1,860
Problem fertilizers as a percentage of total[3]	38	36	48	47	45
Region 4:					
Problem products[1]	4	1,667	26	11,141	30
Other products	751	261,253	601	223,810	1,352
Total	755	262,920	627	234,951	1,382
Problem fertilizers as a percentage of total	1	1	4	5	2
Region 6:					
Problem products[1]	16	11,135	38	23,347	54
Other products	450	203,262	728	331,986	1,178
Total	466	214,397	766	355,333	1,232
Problem fertilizers as a percentage of total	3	5	5	7	4
United States:					
Problem products[1]	253	104,829	772	320,976	1,025
Other products[4]	6,104	2,195,073	6,734	2,629,897	12,838
Total	6,357	2,299,902	7,506	2,950,873	13,863
Problem fertilizers as a percentage of total	4	5	10	11	7

[1]Problem products from table B-4, those with possible statistical error.
[2]Region 3, 5, and 7 have no problem products.
[3]The only comparison exceeding 33 percent.
[4]See table C-1; numbers do not equal sum of farm regions.

Table B-2—Weighted average cost per nutrient ton of fertilizer by 1975[1]

Region	Cooperatives	Non-cooperatives	Difference		Accuracy index
	Dollars			*Percent*	
Region 1:					
WAP	539	503	+36	+6.7	
WAC	384	422	-38	-9.0	15.7
PAC	383	421	-38	-9.0	
Region 2:					
WAP	381	392	-11	-2.8	
WAC	401	408	-7	-1.7	1.1
PAC	400	407	-7	-1.7	
Region 4:					
WAP	417	428	-11	-2.6	
WAC	348	375	-27	-7.2	4.6
PAC	347	373	-26	-1.0	
Region 6:					
WAP	696	614	+82	+11.8	
WAC	460	464	-4	-.9	12.7
PAC	460	464	-4	-.9	
U.S. average:					
WAP	414	416	-2	-.4	
WAC	362	393	-31	-7.9	7.5
PAC	361	392	-31	-7.9	

[1]Regions 3, 5, and 7 have no problem products.

Terms:

WAP = Weighted average cost of problem products, from table B-1.

WAC = Weighted average cost of all products, column three, table C-1.

PAC = Projected average cost of all products, column four, table C-1.

Table B-3—Difference in cooperative and noncooperative predicted average cost, per nutrient ton, by type of fertilizer and region, year ending June 30, 1975

Item	Unit	Liquid mixtures	Straight nitrogen materials	N-P materials	Dry blends	Dry mixtures	[illegible]er[1]	Total
Region 1:								
Cooperative difference	$/ton	-26.33	+61.28	-95.16	-54.64	-5.71	+143.64	-37.82
Calculated t-value	--	-.608	+1.834	-10.167	-1.846	-.429	--	-2.239
Significant[2]	--	No	No	Yes	No	No	--	Yes
Region 2:								
Cooperative difference	$/ton	+166.84	+19.24	-23.32	-19.66	-.62	+32.26	-7.05
Calculated t-value	--	+2.030	+1.026	-.847	-.922	-.024	--	-.561
Significant[2]	--	Yes	No	No	No	No	--	No
Region 3:								
Cooperative difference	$/ton	+9.01	-3.77	-19.41	-10.75	-18.72	+12.33	-27.77
Calculated t-value	--	+.341	-.383	-1.221	-1.586	-1.312	--	-5.806
Significant[2]	--	No	No	No	No	No	--	Yes
Region 4:								
Cooperative difference	$/ton	-58.31	-28.27	+5.14	-46.68	-15.00	+12.94	-26.00
Calculated t-value	--	-1.594	-.861	+.768	-1.645	-.882	--	-1.806
Significant[2]	--	No	No	No	No	No	--	No
Region 5:								
Cooperative difference	$/ton	-67.36	-8.17	+8.97	-14.61	+12.97	+14.83	-20.60
Calculated t-value	--	-1.639	-1.071	+.733	-1.616	+.631	--	-3.759
Significant[2]	--	No	No	No	No	No	--	Yes
Region 6:								
Cooperative difference	$/ton	-59.33	+.91	-51.53	+35.02	-19.64	-4.02	-3.96
Calculated t-value	--	-1.483	+.027	-1.873	+.674	-.541	--	-.197
Significant[2]	--	No	No	No	No	No	--	No
Region 7:								
Cooperative difference	$/ton	.97	-67.78	-94.57	-48.16	-67.76	-44.50	-72.57
Calculated t-value	--	-.831	-2.771	-3.747	-1.962	-2.102	--	-4.703
Significant[2]	--	No	Yes	Yes	No	Yes	--	Yes
U.S. average:								
Cooperative difference	$/ton	+5.83	-23.48	-49.51	-20.70	-21.46	+3.80	-31.23
Calculated t-value	--	+.194	-3.331	-4.290	-3.245	-2.686	--	-7.866
Significant[2]	--	No	Yes	Yes	Yes	Yes	--	Yes

[1]Differences are calculated as residual values, making "t" value incalculable.

[2]Result of yes means the per-ton nutrient cost of cooperative fertilizer is significantly lower than the comparable cost of noncooperative fertilizer. Statistically it means the calculated "t" value exceeds a critical value of 2.064, the value for at least 25 respondents at 5-percent level of confidence.

Table B-4—Details on farm fertilizer expenditures on problem products by region and source of purchase, 1975

Fertilizer and Region	Cooperatives		Non-cooperatives		Total volume	All products
	1,000 tons	*1,000 dollars*	*1,000 tons*	*1,000 dollars*	*1,000 tons*	*Percent*
Liquid Mixtures						
Region 1:	1	666	24	11,873	25	.18
Region 4:	2	592	24	10,425	26	.19
Region 6:	16	11,135	38	23,347	54	.39
Straight nitrogen products:						
Region 1:	18	10,055	50	25,500	68	.49
N-P products:						
Region 1:	2	606	4	1,850	6	.04
Region 2:	11	4,308	4	1,623	15	.11
Region 4:	2	1,075	2	716	4	.03
Dry chemical mixtures:						
Region 2:	201	76,392	626	245,642	827	5.96
Total	253	104,829	772	320,976	1,025	7.39

"t" Test Analysis

Doane developed the basis for ESCS to calculate the "t" values on the mean difference between cooperative and noncooperative costs per ton of nutrient. Doane supplied the mean difference in cost per nutrient ton between cooperatives and non-cooperatives ($\hat{R}_d$) and the standard error SE ($\hat{R}_d$). Specific examples are $31.23 and $3.97, respectively, for all fertilizers in the United States (table C-1). All "t" values are identified as, and equal to $(\hat{R}_d) \div SE(\hat{R}_d)$. For more detail, see Appendix A. The "t" values for all region-product combinations are given in table B-3.

Regression Analyses

An extensive series of regression analyses was conducted to measure any correlation that might exist between the market share held by cooperatives and their favorable cost differential. The series included four stages as follows:

— All 35 regional-product combinations

— Selected 24 regional-product combinations

— Selected 16 regional-product combinations

— All fertilizers in seven regions.

The latter sort was made for completeness despite an insufficient number of observations and even some doubt about the observations in two regions.

Correlation factors for each of these stages were calculated for three types of

curves. The first was linear ($y = a + bx$). The second was parabolic ($y = a + bx + cx^2$) where the realtionship of y to x first increases (decreases) then decreases (increases). The third was hyperbolic $\left(y = \frac{1}{a + bx}\right)$ which could have been useful within its asymptotic portions.

The correlation coefficients for each of these sorts are given below:

	Type of Sort (observation count)			
Type of Function:	35	24	15	7
Linear	-0.05	0.19	0.30	0.10
Parabolic	.22	.28	.35	.12
Hyperbolic	.01	-.12	-.04	.34

The 35 regional-product analysis represents all combinations originally designated for this study. These combinations are indicated in table B-3. Other combinations represent data compactions in an attempt to develop higher levels of correlation.

The 24 regional-product analysis uses most of the same combinations previously mentioned, but excludes regional-product combinations with possibly erroneous fertilizer costs. Eliminated combinations are given in table B-1.

The 16 regional-product regression uses all the original data, except liquid mixtures. Thus, it includes only four product groups which were subdivided into four super-regions. Super-regions represent the following combination of regions:

Super-region	*Original Regions*
I	1 and 3
II	2 only
III	4 and 7
IV	6 only

The seven observation analysis is drawn from data on all fertilizer at the regional level only.

Appendix C - Additional Supporting Tables

Table C-1— Total primary plant nutrients: Place of purchase, nutrient tons purchased, dollars spent, average cost per nutrient ton, and standard errors, 1975

Region	Total nutrients[1]	Total spent[1]	Average cost per nutrient ton		Standard error	Standard error, percentage of predicted cost
			Weighted	Predicted[2]		
	1,000 tons	*1,000 dollars*	*Dollars*			*Percent*
Region 1:						
Cooperatives	249	95,737	384.49	383.10	6.41	1.7
Noncooperatives	281	118,515	421.76	420.92	15.64	3.7
Difference	530	214,252	-37.27	-37.82	16.89	44.7
Region 2:						
Cooperatives	560	224,662	401.18	400.28	8.60	2.1
Noncooperatives	1,300	530,456	408.04	407.33	9.13	2.2
Difference	1,860	755,118	-6.86	-7.05	12.56	178.4
Region 3:						
Cooperatives	1,540	517,663	336.14	335.70	3.25	1.0
Noncooperatives	2,148	781,985	364.05	363.47	4.25	1.2
Difference	3,688	1,299,648	-27.91	-27.77	5.46	19.7
Region 4:						
Cooperatives	755	262,920	348.24	347.05	6.24	1.8
Noncooperatives	627	234,951	374.72	373.05	13.07	3.5
Difference	1,382	497,871	-26.48	-26.00	14.40	55.4
Region 5:						
Cooperatives	2,478	873,961	352.69	352.26	3.85	1.1
Noncooperatives	1,703	635,477	373.15	372.86	4.13	1.1
Difference	4,181	1,509,438	-20.46	-20.60	5.48	26.6
Region 6:						
Cooperatives	466	214,397	460.08	459.54	16.46	3.6
Noncooperatives	766	355,333	463.88	463.50	10.76	2.3
Difference	1,232	569,730	-3.80	-3.96	20.06	506.6
Region 7:						
Cooperatives	309	110,562	357.81	357.95	11.85	3.3
Noncooperatives	682	294,156	431.31	430.52	10.30	2.4
Difference	991	404,718	-73.50	-72.57	15.43	21.3
US total:						
Cooperatives	6,357	2,299,902	361.79	361.23	2.57	0.7
Noncooperatives	7,506	2,950,873	393.14	392.46	2.98	0.8
Difference	13,863	5,250,775	-31.35	-31.23	3.97	12.7

[1]Rounded to the nearest 1,000.
[2]Data not rounded.

Table C-2—Liquid mixtures: Place of purchase, nutrient tons purchased, dollars spent, average cost per nutrient ton, and standard errors, 1975

Region	Total nutrients[1]	Total spent[1]	Average cost per nutrient ton		Standard error	Standard error, percentage of predicted cost
			Weighted	Predicted[2]		
	1,000 tons	*1,000 dollars*	*Dollars*			*Percent*
Region 1:						
Cooperatives	1	666	666.00	474.58	37.31	7.9
Noncooperatives	24	11,873	494.71	500.91	21.98	4.4
Difference	25	12,539	+171.29	-26.33	43.29	164.5
Region 2:						
Cooperatives	14	8,548	610.57	590.74	81.49	13.8
Noncooperatives	146	62,056	425.04	423.90	10.72	2.5
Difference	160	70,604	+185.53	+166.84	82.20	49.3
Region 3:						
Cooperatives	37	17,044	460.65	465.49	22.31	4.8
Noncooperatives	194	88,889	458.19	456.48	14.61	3.2
Difference	231	105,933	+2.46	+9.01	26.41	293.1
Region 4:						
Cooperatives	2	592	296.00	367.91	29.79	8.1
Noncooperatives	24	10,425	434.38	426.22	21.17	5.0
Difference	26	11,017	-138.38	-58.31	36.59	62.8
Region 5:						
Cooperatives	57	23,414	410.77	409.49	39.78	9.7
Noncooperatives	213	101,494	476.50	476.85	10.07	2.1
Difference	270	124,908	-65.73	-67.36	41.11	61.0
Region 6:						
Cooperatives	16	11,135	695.94	675.65	35.38	5.2
Noncooperatives	38	23,347	614.39	616.32	18.76	3.0
Difference	54	34,482	+81.55	+59.33	40.00	67.4
Region 7:						
Cooperatives	17	7,427	436.88	432.24	73.40	17.0
Noncooperatives	74	37,098	501.32	497.21	26.73	5.4
Difference	91	44,525	-64.44	-64.97	78.15	120.3
US total:						
Cooperatives	145	68,826	474.66	474.86	29.31	6.2
Noncooperatives	714	335,183	469.44	469.03	6.85	1.5
Difference	859	404,009	+5.22	+5.83	30.12	517.5

[1]Rounded to the nearest 1,000.
[2]Data not rounded.

Table C-3—Straight nitrogen: Place of purchase, nutrient tons purchased, dollars spent, average cost per nutrient ton, and standard errors, 1975

Region	Total nutrients[1]	Total spent[1]	Average cost per nutrient ton		Standard error	Standard error, percentage of predicted cost
			Weighted	Predicted[2]		
	1,000 tons	*1,000 dollars*	*Dollars*			*Percent*
Region 1:						
Cooperatives	18	10,055	558.61	570.66	10.59	1.9
Noncooperatives	50	25,500	510.00	509.38	31.63	6.2
Difference	68	35,555	+48.61	+61.28	33.42	54.5
Region 2:						
Cooperatives	164	78,373	477.88	477.95	12.47	2.6
Noncooperatives	287	131,920	459.65	458.71	13.69	3.0
Difference	451	210,293	+18.23	+19.24	18.76	97.5
Region 3:						
Cooperatives	369	149,638	405.52	405.30	7.35	1.8
Noncooperatives	630	258,124	409.72	409.07	6.35	1.6
Difference	999	407,762	-4.20	-3.77	9.84	261.0
Region 4:						
Cooperatives	227	87,828	386.91	385.07	15.31	4.0
Noncooperatives	180	74,672	414.84	413.34	29.23	7.1
Difference	407	162,500	-27.93	-28.27	32.85	116.2
Region 5:						
Cooperatives	984	350,099	355.79	355.32	5.08	1.4
Noncooperatives	715	260,157	363.86	363.49	6.13	1.7
Difference	1,699	610,256	-8.07	-8.17	7.63	93.4
Region 6:						
Cooperatives	255	117,520	460.86	460.21	26.97	5.9
Noncooperatives	440	202,014	459.12	459.30	16.67	3.6
Difference	695	319,534	+1.74	+0.91	33.67	3,700.0
Region 7:						
Cooperatives	141	48,900	346.81	347.04	19.33	5.6
Noncooperatives	289	120,388	416.57	414.82	14.17	3.4
Difference	430	169,288	-69.76	-67.78	24.46	36.1
US total:						
Cooperatives	2,158	842,414	390.37	389.88	4.93	1.3
Noncooperatives	2,591	1,072,774	414.04	413.36	4.85	1.2
Difference	4,749	1,915,188	-23.67	-23.48	7.05	30.0

[1]Rounded to the nearest 1,000.
[2]Data not rounded.

Table C-4—N-P material: Place of purchase, nutrient tons purchased, dollars spent, average cost per nutrient ton, and standard errors, 1975

Region	Total nutrients[1]	Total spent[1]	Average cost per nutrient ton		Standard error	Standard error, percentage of predicted cost
			Weighted	Predicted[2]		
	1,000 tons	*1,000 dollars*	*Dollars*			*Percent*
Region 1:						
Cooperatives	2	606	303.00	378.06	9.36	2.5
Noncooperatives	4	1,850	462.50	473.22	34.05	17.8
Difference	6	2,456	-159.50	-95.16	9.36	9.8
Region 2:						
Cooperatives	11	4,308	391.64	386.03	23.51	6.1
Noncooperatives	4	1,623	405.75	409.35	14.36	3.5
Difference	15	5,931	-14.11	-23.32	27.52	118.1
Region 3:						
Cooperatives	35	13,218	377.66	382.26	11.01	2.9
Noncooperatives	32	12,810	400.31	401.67	11.49	2.9
Difference	67	26,028	-22.65	-19.41	15.90	81.9
Region 4:						
Cooperatives	2	1,075	537.50	441.38	2.66	0.6
Noncooperatives	2	716	358.00	436.24	5.66	1.3
Difference	4	1,791	+179.50	+5.14	6.69	130.1
Region 5:						
Cooperatives	256	94,354	368.57	368.36	8.36	2.3
Noncooperatives	76	27,199	357.88	359.39	8.94	2.5
Difference	332	121,553	+10.69	+8.97	12.24	136.3
Region 6:						
Cooperatives	80	32,678	408.48	409.38	23.70	5.8
Noncooperatives	117	53,976	461.33	460.91	13.76	3.0
Difference	197	86,654	-52.85	-51.53	27.52	53.4
Region 7:						
Cooperatives	36	12,969	360.25	358.83	12.35	3.4
Noncooperatives	68	30,807	453.04	453.40	22.04	4.9
Difference	104	43,776	-92.79	-94.57	25.24	26.7
US total:						
Cooperatives	422	159,208	377.27	377.37	6.94	1.8
Noncooperatives	302	128,981	427.09	426.88	9.16	2.1
Difference	724	288,189	-49.82	-49.51	11.54	23.3

[1]Rounded to the nearest 1,000.
[2]Data not rounded.

Table C-5—Dry blend: Place of purchase, nutrient tons purchased, dollars spent, average cost per nutrient ton, and standard errors, 1975

Region	Total nutrients[1]	Total spent[1]	Average cost per nutrient ton		Standard error	Standard error, percentage of predicted cost
			Weighted	Predicted[2]		
	1,000 tons	*1,000 dollars*	*Dollars*			*Percent*
Region 1:						
Cooperatives	74	27,307	369.01	368.34	12.04	3.3
Noncooperatives	95	40,300	424.21	422.98	27.02	6.4
Difference	169	67,607	-55.20	-54.64	29.60	54.2
Region 2:						
Cooperatives	126	46,964	372.73	373.02	14.56	3.9
Noncooperatives	216	85,083	393.90	392.68	15.56	4.0
Difference	342	132,047	-21.17	-19.66	21.33	108.5
Region 3:						
Cooperatives	706	227,815	322.68	322.06	3.94	1.4
Noncooperatives	696	232,018	333.36	332.81	5.43	1.6
Difference	1,402	459,833	-10.68	-10.75	6.78	63.1
Region 4:						
Cooperatives	191	62,551	327.49	326.64	10.12	3.1
Noncooperatives	152	57,[illegible]	375.68	373.32	26.34	7.1
Difference	343	119,655	-48.19	-46.68	28.38	60.8
Region 5:						
Cooperatives	919	319,183	347.32	346.89	6.87	2.0
Noncooperatives	518	187,328	361.64	361.50	6.35	1.8
Difference	1,437	506,511	-14.32	-14.61	9.04	61.9
Region 6:						
Cooperatives	73	34,980	479.18	475.85	28.41	6.0
Noncooperatives	86	38,015	442.03	440.83	38.51	8.7
Difference	159	72,995	+37.15	+35.02	51.97	148.4
Region 7:						
Cooperatives	72	25,712	357.11	354.76	16.23	4.6
Noncooperatives	109	44,065	404.27	402.92	18.58	4.6
Difference	181	69,777	-47.16	-48.16	24.55	51.0
US total:						
Cooperatives	2,162	744,511	344.36	343.86	3.80	1.1
Noncooperatives	1,873	683,911	365.14	364.56	5.19	1.4
Difference	4,035	1,428,422	-20.78	-20.70	6.38	30.8

[1]Rounded to the nearest 1,000.
[2]Data not rounded.

Table C-6—Dry chemical mixtures: Place of purchase, nutrient tons purchased, dollars spent, average cost per nutrient ton, and standard errors, 1975

Region	Total nutrients[1]	Total spent[1]	Average cost per nutrient ton		Standard error	Standard error, percentage of predicted cost
			Weighted	Predicted[2]		
	1,000 tons	*1,000 dollars*	*Dollars*			*Percent*
Region 1:						
Cooperatives	143	53,703	375.55	373.54	8.30	2.2
Noncooperatives	97	37,172	383.22	379.25	10.57	2.7
Difference	240	90,875	-7.67	-5.71	13.32	233.7
Region 2:						
Cooperatives	201	76,392	380.06	378.48	10.82	2.9
Noncooperatives	626	245,642	392.40	379.10	23.40	6.2
Difference	827	322,034	-12.34	-0.62	25.74	4,151.6
Region 3:						
Cooperatives	221	77,860	352.31	352.32	7.10	2.0
Noncooperatives	437	162,622	372.31	371.04	12.40	3.3
Difference	658	240,482	-20.00	-18.72	14.27	76.3
Region 4:						
Cooperatives	315	106,497	338.09	336.92	5.89	1.7
Noncooperatives	243	86,048	354.11	351.92	15.94	4.5
Difference	558	192,545	-16.02	-15.00	17.00	113.3
Region 5:						
Cooperatives	161	63,110	391.99	390.62	17.40	4.4
Noncooperatives	123	46,713	379.78	377.65	10.58	2.8
Difference	284	109,823	+12.21	+12.97	20.57	158.5
Region 6:						
Cooperatives	17	7,893	464.29	469.86	25.76	5.5
Noncooperatives	41	19,868	484.59	498.50	25.39	5.2
Difference	58	27,761	-20.30	-19.64	36.29	184.8
Region 7:						
Cooperatives	41	15,051	367.10	370.45	12.79	3.5
Noncooperatives	137	60,318	440.28	438.21	30.12	6.9
Difference	178	75,369	-73.18	-67.76	32.23	47.6
US total:						
Cooperatives	1,098	400,508	364.76	363.54	4.32	1.2
Noncooperatives	1,705	658,384	386.15	385.00	6.74	1.8
Difference	2,803	1,058,892	-21.39	-21.46	7.99	37.2

[1]Rounded to the nearest 1,000.
[2]Data not rounded.

COOPERATIVE PROGRAM

U.S. Department of Agriculture
Economics, Statistics, and Cooperatives Service

The Cooperative Program of ESCS provides research, management, and educational assistance to cooperatives to strengthen the economic position of farmers and other rural residents. It works directly with cooperative leaders and Federal and State agencies to improve organization, leadership, and operation of cooperatives and to give guidance to further development.

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