INDUSTRY CHANGES IN FEED, FERTILIZER, PETROLEUM, AND OTHER CHEMICAL PRODUCTS USED IN FARM PRODUCTION

by George R. Allen*

My purpose is to highlight major technological changes in manufactured feed and agricultural chemical industries which, in the next five years, or so, will have a major impact on the markets for farm inputs - affecting prices, farm practices, methods of marketing and financing, and the possible development of farm planning services from the private sector.

Petroleum products are likely to exert a completely passive influence. They appear even now in many areas to be yielding less than a normal return at retail. They may be introduced into some of the new farm service centers to extend product range and to help towards overheads. Even so, petroleum products are one of the least important influences making for change in the market situation for farm inputs. I shall not refer to them again.

Turning to the other three groups - fertilizers, feeds and farm chemicals - the market for plant nutrients will show the greatest adjustment over the next five years. Working from a base period of, say, 1962-1965, one can highlight the following:

1. Fundamental changes in the economics of the nitrogenous materials, due to lower production costs both in the new ammonia plants and in associated conversion facilities.

2. As compared with the period 1962-1965, major reduction in the price of potash, associated with new low cost mining in Canada.

3. An equally strong but upward movement in the price of sulphur, a critical ingredient in the phosphate fertilizer processes commonly used in the U.S. This is in part the consequence of the rapid move to higher analysis materials since 1962.

4. A continuation of the rapid growth in domestic consumption of fertilizers, 8.9% annually in terms of plant nutrient from 1959/60 through 1963/64, for the next four or five years. In addition, a three to fourfold increase in annual fertilizer shipments to underdeveloped countries.

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These changes, to which others could be added, represent the biggest shake-up of economic forces in the fertilizer economy since the agricultural recession following the Korean War. Looking back in 1970 we shall probably regard 1964 and after as one of the most rapid periods of cost reduction and technological advance in the North American fertilizer industry since 1945.

**Future Potential for Fertilizer**

The most publicized changes are occurring in the production of ammonia and potash, but they are also found in the manufacture of nitric acid, other nitrogenous materials, and in phosphates. The most striking of all is deep mining of potash in Saskatchewan. By freezing the Blairmore Layer, shafts have been sunk to reach the largest deposits currently in use and, in relation to its markets in North America and abroad, one of the lowest cost sources of potash in the world.

The optimum size fertilizer plant is becoming much larger. Whereas a few years ago units of 300 tons/day or 400 tons/day were considered to be large, the new ammonia units coming on stream range in size from 1000 tons/day to 1500 tons/day if located close to natural gas and 600 tons/day to 800 tons/day if located within the main mid-west markets. In potash, the Saskatchewan mines in 1970 will have individual annual capacities mostly ranging from around 1,150,000 tons.

The locational pattern of the fertilizer industry is changing, with manufacturing plants being located further from the main domestic markets. This new geography of the fertilizer industry is a result of new mining and manufacturing technologies and higher nutrient content of materials, as well as new attractions in the export market. Ammonia plants aiming at only the mid-west market are best situated there, but the Mississippi Delta has demonstrated its attraction for those which seek greater geographical dispersion of outlets. The phosphate industry has generally moved nearer to the source of rock, although some recent development underline the growing importance of the Delta.

The new geography of the fertilizer industry is producing many changes. One is the logistic problems in supplying the mid-west market, especially in meeting the peak spring demand. The pressures to boost fall application of fertilizers, including anhydrous ammonia, will increase. Another consequence is the increasing importance of the river network as a competitive factor in the mid-west fertilizer distribution system.
In the last year there has been much discussion on prospective oversupply in N, P and K fertilizers. These appraisals underestimate the influence of a number of factors making for a more orderly growth of supply relatively to demand. The prospective demand for U. S. produced fertilizers is frequently underestimated, as well as the industrial markets for some of these materials. This is discussed in more detail later.

In the ammonia industry, new plants are starting up behind schedule and are experiencing slower start-ups and approaches to full operating capacity than has been the earlier case with smaller plants embodying a more established technology. Finally, many of the announcements of new projects, particularly in potash, may not take place or may be deferred, especially in view of the tightening cash flows of 1966 and 1967.

Since around 1956 the average price of fertilizers to the farmer has not increased, while other inputs have become much more expensive. For example, farm machinery prices have increased over the period by around 50% - and farm land by slightly more. These relative movements in the prices of farm inputs, to the advantage of fertilizer, are expected to continue.

Other factors will reinforce the rising demand for plant nutrients. First, the fertilizer/crop price ratio for 1966-1970 is likely to be more favorable to fertilizers than in 1962-1965 - the base period of the review. By then, the opening of networks of company-owned retail outlets will increase selling efforts. Finally, the retirement of land in the mid-west under Government programs in the early 1960's has stimulated farmers to a greater awareness of the economic opportunities for substituting fertilizer for land. These opportunities are probably as great today as they were in 1960, due to new crop technologies. The pace-setters of the Corn Belt farming community now aim for 200 bushels/acre, not 150.

All this means, in my opinion, that the prospective growth in fertilizer use in the U. S. through 1970 will be much higher than indicated by most published projections. I think it is likely that by 1970 U. S. agriculture will have increased its ability to meet the food needs of underdeveloped countries and, at the same time, be utilizing not much more land than in 1964 or 1965. This will be achieved by yields and rates of fertilization not thought possible a few years ago. My estimates through 1970-71 are shown in Table 1.1.
Table 1.1. Annual Rate of Growth in Consumption of Plant Nutrients

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<tbody>
<tr>
<td>N</td>
<td>10.4%</td>
<td>12.4%</td>
<td>10.0% - 13.0%</td>
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<tr>
<td>P</td>
<td>5.8</td>
<td>7.0</td>
<td>6.5 - 9.0</td>
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<tr>
<td>K</td>
<td>4.5</td>
<td>6.1</td>
<td>6.0 - 8.5</td>
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<tr>
<td>Total</td>
<td>7.2%</td>
<td>8.9%</td>
<td>7.9% - 10.7%</td>
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The U.S. potash industry faces competition from lower cost Canadian supplies. But otherwise, especially in nitrogenous materials, U.S. fertilizer products have the cost advantage over other major exporters, mostly in West Europe. Further, AID fertilizer exports are expected to increase four-fold in the next few years. Finally, industrial uses for nitrogen and phosphates appear to be growing at least as rapidly as in the farm market.

Sulphur is currently in short supply and is expected to remain tight through 1968. The situation thereafter is conjectural, although in my opinion an easing of the overall world supply position is to be expected. Looking through to 1970 and beyond, the most important aspect of the current sulphur shortage is not its effect on fertilizer prices, but the stimulus it may give to new fertilizer technology. Taken together with the prospective cheapening of ammonia and nitric acid, current sulphur prices are causing the economics of nitric acid as an acidulent for phosphate rock, in place of sulphuric acid, to be closely reviewed.

In the U.S. virtually all phosphatic fertilizers are produced by acidulation processes based on sulphur. In Continental Europe, in contrast, large proportions of the phosphate industry's output come from either straight nitro-phosphates, in which the only acidulent is nitric acid, or modified nitro-phosphates in which nitric acid is partially substituted for sulphuric and phosphoric acids.

Little progress is likely with straight nitro-phosphates. They are low in water solubility and unsuitable where quick release of nutrients is required, as in pre-plant fertilization of corn. Also, the by-product materials would
have much more limited value in the U. S. than they do in northwest Europe. Modified nitro-phosphates are a more serious contender, especially as they can meet required conditions on water solubility.

It seems necessary to re-evaluate the part which nitro-phosphates can play in U. S. agriculture. So far, there is no sign of action. But, the economics of nitro-phosphates needs continual and close review. To anyone who would deny them any significant role, one question can be posed. Are there not important agricultural areas in the U. S. where the agronomy and economics of fertilizer use approximate conditions ruling in those parts of Europe where nitro-phosphates are accepted completely?

Future Potentials for Manufactured Feeds

Manufactured feed do not offer the same prospects for changes as the fertilizer industry.

The opportunities for reducing manufacturing costs are extremely limited.

Scientific advances in animal nutrition generally appear to be coming forward much more slowly than in the 1950's. The use of antibiotics and micro-nutrients seem to be clearly defined. Metabolic regulators could be important, and are urgently needed if the beef industry is to avoid decreasing returns while maintaining a 3%-4% annual average increase in output. But very little progress appears to have been made.

The most important, but still partially developed, business opportunity is the substitution of urea for animal and vegetable protein, a move which is in part connected with the use of liquid supplement feeds.

In the last few years a number of trends have been established which are important to the individual feed manufacturer or farmer. However, even in the aggregate these developments will not have a large effect on meat prices. The feed industry is technologically too mature. Briefly, they are:

1. A continuing decline of mobile grind-and-mix services which are being replaced mainly by mixing units confined to a single livestock enterprise and either owned or leased by it.
2. There will probably be some recovery in the importance of factory-mixed complete feeds for hogs and cattle for sale on a long-term contract basis to large operations: say over 5,000 head capacity in the case of cattle.

3. At the same time, the growth in sales of supplement feeds in bulk relatively to bagged materials will continue.

4. Regional feed companies may grow at a more rapid rate than the national giants of the industry. This is linked with the increasing importance of market-oriented mills, serving a radius of around 50-100 miles. Some regional companies, in exceptionally close contact with the customer, have already demonstrated this point.

Related Developments Affecting Manufactured Feeds

Looking further down the road, it seems necessary to highlight three developments.

1. High lysine corn; contract growing of feed grains.

2. The use of urea, and it relation to liquid feed supplements.

3. The development of large-scale cattle and hog operations in mid-west, particularly full environment-controlled cattle fattening and dry-lot cow-calf operations.

High lysine corn is probably 6-7 years off commercialization. From the viewpoint of the economics of livestock feeding its potentiality has yet to be defined. There is on present evidence still some strong doubts whether, as against existing varieties, yield will be sufficiently high to justify its extensive use as a hog feed. However, if the yields can be obtained and taking into account possible rapid increases in the average size of hog operations, the structure of the feed industry will change dramatically. The emphasis in manufacturing will switch away from supplement feeds containing the full component of proteins and other nutrients to base mixes of vitamins, antibiotics, trace minerals, and such amino acid fortification as necessary to make good deficiencies in the corn.
Base mixes require even more careful mixing than supplements and, being of higher value in relative weight, reduce the influence of freight costs. In these circumstances there would be a move away from the regional mills which have now become typical and back to larger units serving, say, 200-300 miles radius.

The quantity of urea used as an animal feed is not known, largely because fertilizer grade material are commonly employed. It was probably 250,000-300,000 tons in 1965, and rising fast. The technical literature frequently gives the impression that the recent growth in the use of urea as a feed has been the consequence of feeders finding that the toxic dangers were much less than had been thought originally. This change of attitude has been a necessary, but not a sufficient condition. More important, the economic incentive has changed in the last five years, compared with the 1950's.

Dr. George Kromer of the U. S. D. A. has prepared an approximate measure of the relative profitability of using urea and soybean, by comparing a mixture of 1715 pounds of grain plus 285 pounds of urea (priced at $100/ton) against the price of a ton of soybean meal, 44% protein. (This is obviously a very rough yardstick and should be used, as the corn/hog ratio, only as an approximate guide to profitability.)

During the period 1954-1959 the corn-urea mixture never enjoyed a cost advantage of more than $6.70/ton. Subsequently, its advantage has been:

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<th>Year</th>
<th>Advantage</th>
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<tbody>
<tr>
<td>1960</td>
<td>$13.9/ton</td>
</tr>
<tr>
<td>1961</td>
<td>16.7</td>
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<tr>
<td>1962</td>
<td>22.0</td>
</tr>
<tr>
<td>1963</td>
<td>20.8</td>
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<td>1964 (Oct.-Dec.)</td>
<td>18.2</td>
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In view of expected cost reductions in the manufacture of nitrogenous materials -- lower ammonia prices and economies of scale in the new large urea plants, and stronger soybean prices compared with those in 1960-1964 -- the advantage should move further in favor of urea mixture.

The role of urea has been widened by the development of liquid supplement feeds with a molasses base, such as Iowa 80 and Purdue 64. It might
be asked how soon will the expanding use of liquid supplements be limited by an ultimate inelasticity in the supply of molasses. In the foreseeable future this is unlikely, in view of the world sugar situation. Further, a pulp-wood by-product is now available as a molasses substitute and is sold commercially.

The most conjectural issue, looking out 10 years, is whether the size structure in mid-west feedlot operations will change radically. The economics of joint enterprises is normally advanced to justify the continued viability of the existing pattern of small-scale feeding. But, there are at least three factors favoring large units.

First, the ability to reduce business uncertainties, especially with the opportunities provided for hedging in the new livestock future markets.

Second, there are the opportunities for increasing TDN by harvesting the complete growth of corn, stalks and all. This, it appears, involves the ability to control either directly or by contracting, the output of around 1000 acres of average corn land if equipment is to be used efficiently.

Third, and most important of all, there is now the strong likelihood that the Corn Belt can economically overcome its climatic disadvantages and achieve the feed conversion rates of the High Plains, as well as getting around the mud problem, by introducing environment-controlled indoor feeding.

Iowa Beef Packers have, of course, aroused interest in environment-controlled feeding by their announcement about a year ago that they were considering establishing a unit, or units, near Algona (Iowa) to turn out 50,000-100,000 cattle annually. A number of small operations – 300-500 head/capacity – have already been started by other feeders. The necessary fixed investment is less than $100/head, and probably around $40/head more than in the High Plains. At a superficial glance, this seems a small price to pay to offset the Corn Belt's climatic disadvantages and to maximize its advantages of accessibility to feed and markets and, especially if it develops its grass potential, to feeder cattle.

Within the next five years environment-controlled beef production seems likely to be important within the Corn Belt. There is, however, insufficient information to develop a sound projection of its rate of growth. One thing seems certain, this issue deserves much more attention than it is currently receiving.
It is too early to say how mid-west supplement feed manufacturers would react to the development of large-scale environmental feedlots in the mid-west, should they develop. In other areas where large feeding units have emerged, as in the High Plains, feed manufacturers have not integrated into cattle feeding. It has been advantageous to all concerned for feed supplement manufacturing and for feeding to retain their separate identities. This, too, seems likely in the mid-west.

Concluding Observations

Many important developments are occurring in farm chemicals. These are not discussed here. This may seem a cavalier treatment in view of their actual and potential effects on farming methods. However, although they call for added skills on the part of dealers and managers of company-owned farm service centers, it seems unlikely that they will have any direct effect on the structure of the marketing system for farm inputs.

In net, the picture I wish to present is one in which technical change has been, and is, taking place extremely rapidly in the mining and manufacture of fertilizer materials and in farm chemicals, and also to a lesser degree in manufactured feeds. I have described some of the more important changes in order to provide a base from which anyone wishing to analyze the structure of these industries can proceed. Any appraisal of structure, of course, involves many additional considerations to those in this paper, especially governmental policy towards vertical integration in agribusiness and towards recent and possible future mergers in the fertilizer industry.

However, the main impression I wish to leave is that technical features I have highlighted, as well as some others which could have been explored, will have a much greater direct effect on the prices of farm inputs than other considerations which usually figure prominently in discussions of structure and performance of agribusiness. At the same time, any indirect effects of technical changes on the structural evolution of the industries under review is, in terms of their economic implications, a secondary issue when compared with their direct influence on prices of fertilizers, feed and farm chemicals.