PRODUCTIVITY IN THE FERTILIZER INDUSTRY: INORGANIC FERTILIZERS

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Introduction

The following five numbers that help to place the present position of the fertilizer industry in perspective:

	R million (approx.)
• *Total replacement* value of the industry,	2 800
• *Gross sales* value in 1985 if the price control formula had been applied to calculate selling prices,	1 000
• *Actual gross sales* figure, lower than formula owing to under-recovery of cost of imports and other cost increases)	920
• *Actual net sales value* (lower than gross to the extent of competitive discounts only)	820
• *Combined 1985 pre-tax profit* of the of the fertilizer industry	(15) loss

These numbers can only be approximate since separate accounts of fertilizer activities are not published by most companies in the industry. With the industry running at about R180 million lower revenue than that required to give the mediocre returns under price control, the effects on profitability have been interesting. How has productivity been related to this state of profitability?

Before we can discuss this, we need to clarify our understanding of productivity.

Productivity and price recovery

Table 1 presents a variety of cost indices for the years 1980 (= 100) to 1985. It will be seen that the index of net fertilizer selling prices to the farming community at 191 in 1985 was lower than the consumer price index (196) and lower than most of the raw material and other input indices.

Let us take a hypothetical South African fertilizer company dependent on imports of ammonia, potash, and sulphur whose input costs in 1980 were the percentages of gross sales shown in Table 2. The distribution of costs leaves a pre-tax profit of three per cent of gross sales. After escalating each item to 1985 values by the indices from Table 1, the company performance is seen to decline to a loss of 25 per cent of gross sales.

None of these cost, selling price or profit changes is directly related to productivity; indeed productivity has tacitly been assumed constant in this calculation since input quantities have all been held at their original 1980 levels. Profit changes result from a combination of a productivity element and a price recovery element, and it is only the latter which has been changed above; but in practice the productivity element has helped to prevent losses from becoming as bad as in this example, or fertilizer prices from rising higher.

The productivity element has four main components, namely raw material, energy, labour, and capital productivities. For example, the units of fertilizer output achieved per unit of raw material input defines the raw

TABLE 1. Cost Indices, 1980 (= 100) to 1985

			Raw Materials				Other Inputs		
	(3) Inflation (CPI)	(3) Fertilizer	(2) Ammonia	(5) Phosphate Rock	(2) Potash	(2) Sulphur	(4) Fuel	(4) Electricity	(6) Railage
	1980 = 100								
1980	100	100	100	100	100	100	100	100	100
1981	115	106	130	100	102	100	104	118	117
1982	132	122	136	109	84	118	121	159	140
1983	148	139	175	133	100	122	119	185	162
1984	166	145	210	141	143	254	112	191	187
1985	196	191	271	156	228	382	141	218	208

(2) Rand value of imported products
(3) Source: Abstract of Agricultural Statistics 1986
(4) Source: Directorate Agricultural Economic Trends
(5) Foskem (Pty) Ltd
(6) Based on Tariff 14, 500km distance. Calculations: FSSA

TABLE 2. Income statements of a hypothetical fertilizer company

	Percentages Gross sales in 1980	1985 indices from Table 1	1980 Items escalated to 1985	Percentages Gross Sales in 1985
Gross sales	100	191	191,0	100
Selling Charges (8% of Gross Sales)	8	191	15,3	8
Net Sales	92			92
Less: Total Costs made up of:	89			117
Nitrogen	36	271	97,6	51
Phosphate rock	5	156	7,8	4
Sulphuric acid	13	382	49,7	26
Potash	6	228	13,7	7
Railage	8	208	16,6	9
Bags	4	196	7,8	4
Electricity	2	218	4,4	2
Fuel	1	141	1,4	1
Other fixed costs	11	196	21,6	11
Depreciation	1		1,0	1
Finance Charges	2		2,0	1
Pre-tax return	3			−25

material productivity, and the others follow analogously.

The CPI rose from 100 in 1980 to 196 in 1985, while the weighted average index of imports of ammonia, sulphur and potash rose to 293. In contrast, the fertiliser selling price index rose to 191. One can deduce that five per cent of the local inflation and 53 per cent of the potential imported inflation since 1980 has been absorbed or circumvented by the fertilizer industry. To help achieve these results, improvements have been earnestly sought and made in the areas of both productivity of inputs and input prices. We can identify three major categories of such improvement.

Raw material cost reduction campaigns

The first category of improvement relates to the main fertilizer raw materials (ammonia and other forms of raw material nitrogen, sulphur, phosphate rock and potassium) which typically account for over 50 per cent of gross sales value.

It is here that the largest productivity and input price improvements have been made. The change to local processing, which has been taking place steadily over many years (first local ammonia, 1931; establishment of Foskor, 1951; first local urea, 1959; first local phosphoric acid, 1964; first synthetic coal-based ammonia, 1974; etc) is continuing with the advent of more local raw materials. For example, in 1985 Sasol began producing elemental sulphur at Secunda. This sulphur could exceed 160 000 tons/year within about two years, which could be made into sufficient sulphuric acid to produce about one third of South Africa's current phosphate fertiliser demand. The growth and utilisation by the fertilizer industry of sulphuric acid from gold, platinum, and base metal mines, recovery operations such as Ergo, and other local sources, including Sasol's sulphur, is such that imports of sulphur for local fertilizers could fall away completely within the next year of two. This trend was apparent in last year's statistics for Canadian sulphur exported to the Republic of South Africa, which fell by half from 361 000 tons in Jan-June 1984 to 179 000 tons in Jan-June 1985. Local sulphuric acid prices are generally below that from imported sulphur, and for the country as a whole there is much more added value in using alternatives that are entirely indigenous in origin.

Ammonia and other nitrogen imports have also declined — indeed for most of 1984 South Africa was a net exporter of ammonia, and it is continuing to hover close to the balance point if re-exports of nitrogen are excluded. This trend is largely due to the decline in local market demand, but the advent of ammonia from Sasol 2 (1983), Sasol 3 (1984), and the de-bottlenecking of both of these plants and of AECI's coal-based ammonia plant have all contributed to the present self-sufficiency. Today about 93 per cent of South Africa's ammonia is ultimately derived from coal, and is therefore correspondingly indigenous.

The production of ammonia (or petrol) from coal is extraordinarily capital intensive, but this feature is offset by low input costs. With a modern process the input coal typically costs less than 20 per cent of the corresponding output ammonia value. Much of a substantial margin becomes available to provide a return on the

large investment. This return will initially be inadequate by most standards, but as the years roll by the margin inflates while the initial investment remains static. There is thus effectively an inflationary increase in capital productivity, as long as the plant can be maintained in operation; but Sasol 1 and AECI 2 have shown that over thirty years of operation is feasible. This benefit is clearly never available from imports. The greater the local content of our fertilizers, the more opportunities exist for improving productivity.

One measure of the effect of local content is the relationship between local fertilizer selling prices and equivalent import parities. With the exception of plain potash, which is still all imported since no economically viable local deposits exist, a calculation in January 1986 showed that local fertilizer list prices ranged from 5,4 per cent to 24,6 per cent below import parity — and this calculation excluded import duty from the cost of imports.

Operating cost reduction campaigns

All companies have embarked on various campaigns of belt-tightening and cost reduction. At least three major fertilizer producers made public announcements of large-scale staff retrenchments during the past two or three years, and other cuts were made without publicity. In our organisation, better methods of loss control management were introduced; financial controls, which were in any case being changed to deal with the move away from price control, were tightened; long term planning, which had been upset by the unpredictable pattern of sales, was trimmed back in favour of more flexible short-term planning; and attempts were made wherever possible to reduce so-called fixed costs in proportion to lower sales volumes. At our factories, efforts were made with renewed vigour to improve conversion efficiencies, to find cheaper additives and other chemicals, and to cut losses or wastage in any form throughout the spectrum from raw materials worth millions per year to the proverbial paper clips.

A particular aspect of operating cost reduction campaign has been the variety of rationalisation activities that have been undertaken within the industry. Fertilizers are for the most part simple chemical salts of a commodity nature, and the regulations under the Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act (No 36 of 1947) as amended effectively prevent product differentiation by means of special ingredients or additives other than trace elements. Each producer's fertilizer products are therefore for the most part interchangeable with those of any other producer, and many rationalisation steps and product exchanges have taken place to avoid unnecessary duplication of production facilities, and to avoid cross-railage. Some examples of these rationalization steps known to my company include:

(i) The exchanges of ammonia and of explosives-grade ammonium nitrate supplied by Fedmis to AECI in the Cape, for ammonia and LAN supplied by AECI in the Transvaal.

(ii) NPK's and LAN from Fedmis to Sasol in the Cape are exchanged for similar products from Sasol to Fedmis at Sasolburg.

(iii) Fedmis supplied phosacid to Triomf at Potchefstroom, and received phosacid from Triomf at Richards Bay (for exports).

(iv) Sasol sends sulphur for conversion to phosphoric acid by Fedmis, which uses its spare capacity at Phalaborwa and saves the capital cost of a new phosacid plant.

(v) Again to reduce capital outlays, Fedmis sends ammonia to Omnia for conversion to ammonium nitrate solution, under a contractual agreement which enabled one large nitric acid/ammonium nitrate plant to be built in 1983 rather than two smaller and less economical ones.

(vi) Joint imports of sulphur by all importes, and

(vii) Joint imports of potash by the whole industry — both of these items resulting in significant savings in freight costs.

It can be seen that Fedmis has rationalisation measures with all four of its competitors, and numerous other examples undoubtedly exist throughout the industry. The resulting benefits are passed on to the farming community.

The various facets of the operating cost reduction programmes have contributed to important improvements in the raw material, energy, and labour elements of productivity.

Technological innovation

The third major category of input price improvement, but more particularly in this case of productivity as well, is technological innovation. Numerous examples can be quoted here, of which I have chosen nine. In a surprising number of cases for a country producing less than one per cent of the world's fertilizers, the South African industry has achieved technological world firsts or eminent positions.

(i) *Ammonia from coal:* South Africa is in a leading position world-wide in the production of both synthetic and by-product ammonia from coal. The high proportion of added value, the growing capital productivity (which confers comparative advantage on this process later if not sooner), and the savings in foreign exchange are important aspects of this field of technology development.

(ii) *Producer gas as fuel:* To meet a growing price and scarcity of refinery gas as fuel for the Cape am-

monia plant, it has been converted to use producer gas from coal as its fuel source at less than half the refinery gas cost. Both the use of producer gas to fire a large steam reforming furnace, and its retrofit, are unique world-wide.

(iii) *Recycling of phosphogymsum:* Only in South Africa and Austria is phosphogypsum, normally a waste product of the phosphoric acid process, recycled to produce cement and sulphuric acid. The local technology is further advanced; for example our process uses 100 per cent phosphogypsum feed, the Austrian one only 50 per cent, the balance being natural gypsum. The intake of sulphur (or sulphuric acid) into a plant utilising this process is typically reduced to a make-up stream of less than one sixth of the normal requirement, and the cost of this residual make-up is more than covered by the extra sales revenue fromt he by-product cement.

(iv) *Pipe reactor technology:* Experts from the USA National Fertilizer Development Centre, where much development work on pipe reactors for ammonium phosphates has taken place, have stated that an unusually broad variety of NPK fertilizers has been produced on South African pipe reactors which have been, widely adopted by the local industry. The use of pipe reactors leads to much improved capital productivity.

(v) *Combatting of ammonium nitrate degradation:* In warm climates, ammonium nitrate and mixtures which incorporate it (including LAN) can deteriorate rapidly as a result of daily temperature fluctuations above a critical 32° Celsius crystal transition temperature. The granular fertiliser turns to a hygroscopic powder within a few sunny days, and causes application problems for the farmer. South African development work has led to patented cost-effective stabilisation techniques for these ammonium nitrate products, and equipment used in the Cape to achieve stabilisation is believed to be the only one of its type in the world.

(vi) *Bulk blending:* With the aid of stabilised LAN, and of stable ASN (granular ammonium sulphate nitrate — another local development), bulk blending has become more practical. This is opening the way to overall cost savings as a result of both transport savings, and the opportunity for the farmer to buy prescription mixtures when a standard NPK ratio is not suited to his requirements.

(vii) *Semi-bulk and bulk fertilizers supplies:* Most fertilizer companies can now offer fertilizer in semi-bulk (half tonne bags) or bulk form, together with advice on the receiving farmer's handling equipment and storage needs. Bags and bagging account for over R20 million per year of total fertiliser cost, so some savings can be achieved here.

(viii) *Liquid fertiliser:* A range of liquid fertilizers is now available to meet those situations, particularly of crops under irrigation, in which liquids can be applied more cost-effectively than solid fertilizers. More than R50 million of South African fertilizers are now applied as liquids, and this proportion is growing.

(ix) *Nitrophosphate technology:* Both liquid and solid versions of this technology have been used and are being developed further to reduce the cost of sulphur and sulphuric acid, and for some producers the foreign exchange element as well. It is interesting that a wider range of fertilizer liquids is probably available in South Africa than throughout Europe, and that similarly there is probably further progress on nitrophosphates in South Africa than in North America.

Conclusion

In the opening remarks to this paper, it was indicated that the South African fertilizer industry's net revenues were estimated to be in 1985 some R180 million below those levels had price control still applied. There are also at list price level from 5,4 per cent to 24,6 per cent below import parity; an average of 15 per cent would correspond to nearly R140 million below import parity. As a result of the drought, the recession, the weaker Rand, high interest rates and the near-collapse of export markets, the industry is suffering from severe economic hardship, as shown by the estimated combined pre-tax loss of the fertilizer companies of R15 million; but innovation and productivity within the industry have lessened this hardship from a still worse position, and will ease the path back to economic normalcy while enabling the industry to continue providing the South African agricultural community with good quality fertilizers at world-competitive prices.