Fertilizer Producer Pricing in Developing Countries
Issues and Approaches

Edilberto L. Segura, Y. T. Shetty, and Mieko Nishimizu, editors
Fertilizer Producer Pricing in Developing Countries

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ABSTRACT

This report presents the proceedings of the "International Seminar on Fertilizer Pricing Policies" sponsored by the Industry Department of the World Bank in March 1984. It contains three analytical papers on the economic issues raised by fertilizer pricing policies, case studies of actual pricing policies in 10 developing countries and a summary of the seminar discussions.

Participants at the seminar examined the objectives of developing country Governments in promoting increased use of fertilizers by farmers, and the relative merits of alternative pricing schemes, consumer price subsidies and other policies. The discussion focused, however, on the setting of ex-factory prices for producers of fertilizers in the developing world. Regardless of whether ex-factory prices are determined by the free market or by an official agency, to be economically optimal they should perform several objectives, including the provision of stimulus to mobilize and allocate adequate resources for fertilizer capacity expansion, encouragement of the optimal choice of process, effective control of feedstock and other operating costs, satisfactory levels of capacity utilization, and, where necessary, closure of obsolete, high-cost plants. Most developing countries set ex-factory prices either (1) by reference to the estimated costs of domestic producers (usually incorporating target
rates of return on investment that are frequently adjusted on the basis of
different efficiency norms); or (2) by reference to international market
prices—in turn often adjusted to eliminate extreme cyclical variations.
The strengths and weaknesses of alternative approaches were evaluated and
practical recommendations made on improving incentives for efficiency in
the sector.
In most developing countries, fertilizer prices at both producer and farmer levels are determined directly or indirectly by the government. Such government interventions generally have two basic objectives: to provide fertilizers to farmers at stable and attractive prices in order to increase agricultural production through higher fertilizer use, and to encourage domestic production by allowing fertilizer producers a reasonable return on their investments. The specific policies and pricing mechanisms adopted vary substantially across countries, as does their effectiveness.

Fertilizer consumption and agricultural production in developing countries have indeed increased substantially in the last two decades, with the major exception of Sub-Saharan Africa. At the same time, in response to economic difficulties and severe resource constraints faced by most countries, there are increasing concerns about the efficiency of resource allocation and utilization as well as the effectiveness of widespread government interventions in the economies. These concerns have been recently extended to fertilizer pricing policies because of the rising budgetary costs of fertilizer subsidies in many countries and the concerns about the impact of these policies on the efficiency of fertilizer consumption and production.

Fertilizer pricing policies in most countries distinguish between farmer prices and producer prices. The farmgate price of fertilizer is an integral part of agriculture and rural development policies, and is so treated by most countries. On the other hand, fertilizer producer pricing is a part of industrial policy, as it has a crucial impact on resource allocation to the fertilizer industry and on the efficiency of fertilizer production. Fertilizer is a commonly traded commodity, and domestic production is not essential to increase fertilizer consumption and agricultural production. In light of the less than fully satisfactory performance of the fertilizer industry in many developing countries, governments and the World Bank have increasingly focused on issues related to fertilizer producer prices.

In March 1984, the Bank organized an International Seminar on Fertilizer Producer Pricing Policies to exchange views on the objectives of pricing policies for fertilizer producers, the types of pricing systems used in different countries and their effectiveness in meeting the objectives. This Seminar was a part of a series organized by the Bank on important policy issues. The deliberations at the Seminar were very instructive and enlightening. There was consensus that fertilizer producer prices could be based on more objective criteria to reduce subsidies to producers, to improve efficiency of existing plants and to promote development of competitive domestic fertilizer facilities in the future.

Messrs. Segura and Shetty and Ms. Nishimizu, who organized the seminar together with Mr. Dervis, have done an excellent job in finalizing
the papers presented at the conference for publication in the form of this manuscript. In this task they were assisted by Ms. Whitney Watriss, who served as Copy Editor, and Mr. Vinay Swaroop, who worked as Research Assistant.

This report is part of the World Bank's continuing efforts to make widely available the results of its important research and policy work in industry. I believe country policy makers, industry leaders and staff of development assistance agencies concerned with industrial and agricultural policy issues in general and the fertilizer industry in particular would find it most useful.

Harinder S. Kohli
Assistant Director, Policy
Industry Department
World Bank
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APPENDIX: PARTICIPANTS AT THE INTERNATIONAL SEMINAR ON FERTILIZER PRICING POLICIES .................................................. 247
Fertilizer use has been and will continue to be a major factor in the agricultural development strategies of developing nations, just as it has been important in developed countries. Typically, very few nations, even advanced ones, have relied entirely on the free market system to set fertilizer prices. For their part, developing countries have chosen almost uniformly to intervene in the pricing of fertilizers to achieve a variety of national objectives. All too often, their pricing programs have resulted in high levels of subsidies to producers and consumers of fertilizers, inefficient allocation of resources, continued operation of uneconomic firms, and difficulty in evaluating the operational efficiency of enterprises. In many developing countries, the burden imposed on government budgets by the ever-increasing subsidies has become a major concern.

Given these problems, the Industry Department of the World Bank decided to sponsor a Seminar on Fertilizer Pricing Policies. Held in Washington, D.C. on March 27-30, 1984, the seminar was to:

- Review the pricing policies of selected developing countries to promote a better understanding of different systems;
- Evaluate their effectiveness in meeting specified objectives;
- Determine if there is an optimal pricing system; and
- Identify ways to improve pricing policies in selected countries.

Participants in the seminar included representatives of government and industry from 10 developing countries, the UN Food and Agricultural Organization (FAO), COMPLEX (an association of complex fertilizer producers in Western Europe), AGRICO (a major U.S. fertilizer producer), two US universities (Yale and Pennsylvania) and the World Bank. (A full list of the participants appears in the Appendix.)

Following the opening remarks, the representatives of the 10 developing nations provided brief surveys of the pricing systems in their countries, with a follow-up question and answer period after each presentation. In addition, two lead papers entitled "Fertilizer Pricing in Developing Countries: A Market-Based Approach" (by Prof. T. N. Srinivasan of Yale University) and "Designing Incentives for Efficient Production in Large-Scale Enterprises: The Case of Fertilizer Manufacturers" (by Dr. David Sappington of the University of Pennsylvania) were summarized and discussed. The conference then proceeded to a general discussion of the objectives of pricing policies, the types of pricing systems being used today and their effectiveness in meeting the objectives. Participants also recommended areas for future World Bank work.
SUMMARY OF PROCEEDINGS:
INTERNATIONAL SEMINAR ON FERTILIZER PRICING POLICIES

The following summary of the seminar proceedings reviews the highlights of the three-and-a-half days of meetings.

I. THE CONTEXT

Certain themes that came up in the course of the seminar provided the framework for the discussion on fertilizer pricing policies. Foremost was an emphasis on the special circumstances of developing countries and the role they play in defining pricing policies. Those policies aim at multiple and often conflicting national objectives, such as the achievement of self-sufficiency in food, the need to reduce imports through industrial development based on local raw materials, conservation of scarce foreign exchange resources, the desire for assured supplies of fertilizers and foodgrains at stable and reasonable prices, promotion of balanced fertilizer use, and assistance to the weaker sections of society. The second theme was the very important role of fertilizers in achieving the national objective of increased agricultural production and the linkages among fertilizer prices, agricultural production and food prices. The volatility and uncertainty of the international fertilizer market, particularly since the world oil crisis in 1973, were the third theme. Many developing countries feel that because of the above factors, it is not easy to pursue a purely economic approach to fertilizer pricing.

There was, however, a consensus among the country participants that it is desirable to separate ex-factory and farmgate pricing policies in analyzing the burden of subsidies, taking into account the social costs and benefits. In this context, the need for more attention to identifying whether fertilizer subsidies are helping inefficient production facilities was emphasized. The participants felt the objectives, structure and mechanisms for both sets of prices (ex-factory and farmgate) should be discussed independently from each other. It was thought that ex-factory pricing policy can be based on objective considerations. As such, ex-factory pricing systems should be designed in terms of minimizing distortions in order to promote efficient operations and the rationalization and expansion of fertilizer plants.

II. PRICING SYSTEMS

When economic analysis deals with the allocation of scarce resources to alternative uses, it necessarily involves choice and valuation. If there were no scarce resources, all goods would be free goods, and there would be no problem of how to economize on the use of scarce goods. Or, if there were only one use for resources, there would be
no problem of how to allocate the resources to alternative ends. The combination of limited resources and alternative uses requires a price system to allocate the resources. The outstanding merit of an efficiently functioning price system is the attainment of an optimal allocation of resources. The more perfectly the markets are organized—in the sense of being more competitive—the more readily the allocation of resources comes about through the incentives and disincentives provided by the competitive price system of the free market. Changes in demand, the availability and costs of inputs, and technology developments are translated into price signals to which enterprises respond by adjusting their levels of output, production methods and organizational forms. An optimal allocation of resources fulfills the objective of efficiency, i.e., output is maximized when an additional unit of a factor of production of equal quality contributes the same increment to total output in each possible use and receives the same reward in each activity. Over the years, two quite opposite approaches to pricing to analyze applied economic problems have been developed. One approach is the old analysis of Adam Smith, which begins with the presumption that the allocation of resources provided by the simple interaction of market supply and demand is approximately competitive and hence Pareto efficient. Adam Smith portrayed the price market system in his book, *The Wealth of Nations* (1776), as if it were an "invisible hand" that led every individual via the forces of competition, to contribute to the general welfare. By pursuing his own interest he frequently promotes that of society more effectually than when he really intends to promote it." This approach suggests that markets should be interfered with only if a significant "market failure" occurs, and that too with caution.

The other approach believes that market failures are quite common and that the competitive equilibrium paradigm is so far from providing an adequate description of the working of the economy that to rely on it for policy guidance is mistaken. In the real world, market imperfections impede the smoothness and flexibility of resource allocation. Further, past experience as well as recent developments in the theory of public finance and international trade suggest that circumstances may exist in which it is not easy or even desirable to apply a simple version of the world price rule that is normally used as a proxy for competitive free market pricing. These circumstances include: (1) the desire to stabilize producer and/or consumer prices from wide cyclical fluctuations in international prices; (2) the response to non-competitive international market structures; and (3) the need to strike the right balance between improved resource allocation, considerations of income distribution and public revenue, and productive efficiency. In addition, free market pricing may not be the optimal system in many industries that enjoy substantial economies of scale, where economic investments are substantially lumpy and, therefore, domestic supplies increase in large and discrete jumps.

In the fertilizer industry, market imperfections are quite common. In many developing countries, the local fertilizer market is either monopolistic or oligopolistic, as a result of the large-scale investments required in the sector, given the significant economies of scale in fertilizer production. In the world market increasing plant size...
and related economies of scale have resulted in discontinuous increases in production capacity, leading to lengthy, alternating periods of excess supply and excess demand. The oil shocks affected the smooth operation of the fertilizer industry. As a result of these market imperfections, fertilizer prices in the international market have shown large variations over time. Very few countries have allowed these large fluctuations in international fertilizer prices to be followed by their domestic fertilizer industry and passed on to farmers. Therefore, they have established systems for controlling and administering prices, both ex-factory and farmers.

Objectives of the Pricing Systems

The first step in evaluating the effectiveness of the various pricing systems was to define the objectives. Five were identified by the participants.

X-Efficiency and Rationalization of Firms. The price system should motivate firms to increase their operating efficiency and optimize capacity utilization and minimize costs. At the same time, firms should minimize the social costs to the economy as a whole and provide optimum social benefits. Finally, the system should provide signals as to which firms are uneconomic.

Allocative Efficiency. The price system should induce an optimal allocation of resources in the economy. Optimality involves such factors as the timing of investments, plant, location, technology, size, feedstock, and the relative flow of investment funds among all sectors.

Financial Health of Enterprises and Management Evaluation. The price system should: (1) ensure the financial soundness of economically viable enterprises; and (2) facilitate the measurement of the management's performance in different enterprises.

Fiscal Impact. The price system should avoid or minimize the burden of substantial subsidies on the government budget.

Ease and Cost of Implementation. The pricing system should impose minimum costs and administrative loads in its operations.

Ex-Factory Pricing

Based on the review of the pricing systems of the 10 participating countries, it is evident that most follow one of two basic systems: cost recovery (with or without some set rate of return added on), or international price-based. Within those broad categories, six variations were identified.

1/ Among the countries was Nigeria, which does not yet have significant local fertilizer production. Instead, it relies mostly on imports to meet its fertilizer requirements and subsidizes these imports for sale to farmers.
Actual Cost Recovery (e.g., Egypt, Nigeria). Enterprises recover only their actual costs, in some cases exclusive of depreciation. The Government sets output targets for each fertilizer plant in consultation with the fertilizer companies concerned. In some countries, this system includes a bonus for exceeding the targets, and standard costs are used for evaluating efficiency. This system is used mostly in countries where all fertilizer companies are in the public sector and the Government meets the investment requirements of those companies from budget allocations.

In Egypt, ex-factory prices reflect actual cost recovery. Under this pricing system, producers are reimbursed for the cost but receive no profit. An organization for the stabilization of fertilizer prices, the General Organization for Agricultural Prices Equalization (GOAE), calculates the cost of fertilizers (ex-factory). It determines prices, amounts, types and sources of fertilizers to be purchased (including imports) and monitors distribution through the General Organization for Agricultural and Cooperative Credit (GOACC). GOAE functions as a clearing agency, balancing high prices for some farm inputs against subsidies on others. The ex-factory prices are low, and companies show losses even at efficient production. These losses are covered by the Government at the end of the year. Thus, the companies operate on a no-profit, no-loss basis. Their annual investment needs are met from Government budget allocations and depreciation funds of the company.

One of the main disadvantages of such a system is that it does not give the necessary incentives for further investments. There is no reward for productive efficiency, and producers do not have incentives to minimize the cost of production. The consideration of dissuading the operation of plants whose long-term economic viability is questionable does not arise once they achieve the targeted capacity level. The operational feasibility of such a system is only possible when all companies are owned by the public sector. In Egypt, the Government sets quantity targets, and the only incentive to achieve it is a bonus given to industry workers if the target is reached. On the other hand, this system has helped in attaining the policy objective of controlling agricultural prices by means of providing cheap fertilizers to farmers, and the need to provide budgetary allocations and subsidies to the fertilizer sector has been minimized.

Actual Cost Plus [e.g., Pakistan (for old plants), Brazil, Portugal]. Enterprises are compensated for actual costs of operations plus a reasonable return on invested capital or a set margin on sales. One variant is to base the price on the cost of the most efficient firm in the sector (e.g., Brazil, Portugal).
As Pakistan imports large quantities of fertilizers, clearly the value of an additional unit of the locally produced fertilizer would correspond to the value of a unit of imported fertilizer. In practice, however, the price per unit paid to producers is not related to import parity prices but is set on a firm-by-firm, cost plus basis at well below import parity prices. Domestic fertilizer producers have been allowed producer prices on the principle of actual cost plus, which allows after-tax profits ranging from 15 to 20 percent on equity. In some plants that were established earlier, the ex-factory price remains well below the sales price mainly because of the price of gas, which is below the economic cost. Therefore, about 35 percent of the ex-factory price is paid back by such plants to the Government as a "development charge." This revenue helps offset the losses to the Government on higher priced imported fertilizers sold below cost.

The prevailing "development charge" in Pakistan, on the one hand, provides protection from the high import prices and, on the other hand, it acts as a disincentive for operating cost minimization. Although the development charge has minimized the need to provide budgetary allocations and subsidies to the fertilizer sector, this has been at the expense of minimizing the returns to producers. The Government has been able to show a net apparent subsidy of zero or near zero on locally produced fertilizers.

In Portugal, ex-factory prices for fertilizers are set by the Government on the basis of production costs, with the aim of allowing local manufacturers an adequate return on capital. A Governmental commission that consists of representatives of the finance, industry, commerce and agriculture ministries sets the ex-factory fertilizer prices for each year. The commission determines the production costs of the two domestic manufacturers, QUIMIGAL and SAPEC, taking into account raw materials, transportation and the interest rate on capital. A profit margin of 4.6 percent of sales is allowed. The final price is based on the lower of the costs of the two producers.

The Government's concern in Portugal has been how the rate of growth in fertilizer consumption can be maintained while reducing the subsidies to ease the pressure on the budget. Since, QUIMIGAL, one of two domestic producers, is state-owned and accounts for 80 percent of domestic production, the managers' compensation should be linked with the performance of the firm. This would provide an incentive to minimize production costs.

The actual cost plus system blunts the incentive to increase productivity since there is no reward for such an increase. Such a system does not provide adequate incentives to invest in new production capacity, to expand or rationalize existing capacity or to change the cost structure. The operating costs of raw materials, labor and other inputs are not further reduced.

In Brazil, the ex-factory prices for locally produced fertilizers are set quarterly by the Government's Interministerial Prices Council. It takes into account the production costs, fixed assets and working capital
needs of all plants, weighted on the basis of the installed capacity of each unit at 80 percent capacity utilization. On the basis of accounting statements and the demonstrated structure of each plant, efficient producers are allowed a linear rate of return on these items of about 13-18 percent a year after income taxes.

Normative Cost Plus [e.g., India, Pakistan (for new plants), Colombia]. Prices are set according to a formula that enables an enterprise to earn a reasonable rate of return on invested capital only if it is able to achieve prescribed production norms (such as set rates of capacity utilization and input consumption). Departure from these norms results in higher or lower returns. Norms can also be applied to the capital costs for new plants, and incentives can be provided for improvements to existing plants through rationalization. Further, the government can provide an investment tax holiday for certain years to encourage plants to rationalize their existing operation.

In such a pricing scheme, ideally the fair return should be sufficient to attract new capital as old plants depreciate. If the ex-factory price is tied to the firm's fixed assets or capital stock, the firm has an incentive to minimize its variable production costs. In addition, as one of the lead papers suggests, in order to ensure that costs are minimized, managers of firms must be held accountable for the inputs they use in meeting their targets. The compensation of managers could be reduced if the consumption per ton of input exceeds the accepted industry norms. On the other hand, if the consumption of inputs falls below the norm, the managers receive a bonus proportional to the social value of the resources saved.

One of the main shortcomings of such a system is that it induces a firm to "overcapitalize," as the firm's ex-factory prices are based on the amount of capital employed. As one of the papers indicated, some observers call this feature an incentive to build "gold-plated" plants. To a certain extent, the system provides a perverse signal: plant costs do not matter as long as capacity utilization and input norms are met. Furthermore, under this system, many firms appear to be more concerned about justifying their costs to increase the "norm" and be compensated accordingly than to contain or reduce costs. A suggestion was made to identify "yardstick" enterprises to establish standards against which the performance of other firms can be compared. The system may also dampen the incentive to innovate if prices are revised downwards after cost reductions are effected to maintain the fair rate of return.

In India, the Government does not feel that the price of fertilizers should be determined by the "equilibrium" resulting from the interaction of fertilizer supply and demand, but should be derived from the optimal level of the final demand and supply for food. Given the need to increase the food supply, it may be appropriate to maintain, at least temporarily, a "disequilibrium" in the fertilizer market by giving
incentives to farmers to use more fertilizers (demand pull), while providing producers incentives to increase the supply of fertilizers (supply push). This has been achieved by a two-tier system of administered prices—ex-factory (retention) prices and consumer prices. By statute, the Government establishes ex-factory or retention prices of fertilizers for each plant. The Fertilizer Industry Coordination Committee (FICC), a body attached to the Ministry of Chemicals and Fertilizers, fixes the retention prices for each plant for three years, after which they are revised. The fixed and variable costs of production, including interest and depreciation, are determined on a normative basis. A post-tax return of 12 percent (pre-tax 27.5 percent) on net worth is fixed. Net worth is defined as the shareholders' paid-up capital (equity and preference) and the retained earnings of the company. The plants realize this return only if certain norms with respect to the consumption of raw materials, utilities and other inputs are met. There are also certain operating norms. For the ammonia plant, capacity utilization is set at 80 percent. In the case of units manufacturing complex fertilizers using imported phosphoric acid, capacity utilization is based on 6,000 stream-hours. The hourly rate of production of different grades is based on plant design and actual performance.

The retention price formula ensures that any inefficiency that may exist in the industry both during implementation and operation of the projects is not paid for by the farmer through the ex-factory price. If production costs per ton of product were to increase because of a lower level of capacity utilization, such an increase in production cost would not be compensated under the formula. Furthermore, the formula sets retention prices on the basis of normative specific consumption for feedstock, inputs and utilities, although these normative consumption levels are derived from the "normal" performance of the individual plant itself. If actual specific consumption were to be higher, the difference would not be compensated under that formula. The retention price formula does not compensate for most capital cost increases that the plant may have faced during construction. If the project is delayed beyond the original date of mechanical completion, the retention price formula will not compensate for additional pre-operating expenses, additional interest during construction or additional project management charges.

The Government recognizes that during plant operations, plant managers and operators have little incentive to improve performance, thereby contributing to low efficiency in the sector. In order to provide adequate motivation to managers, a system of incentives has been devised and is being used experimentally in three selected plants. This incentive system has two components: one, for capacity utilization and the other, for specific consumption. If a plant operates below 75 percent capacity utilization, no bonuses are given. After the 75 percent capacity utilization is reached, the incentives gradually rise in proportion to the level of capacity utilization reached in a particular month. Similarly, if the specific consumption of raw materials and inputs is below the plants normal consumption as defined in the fertilizer pricing formula, bonuses proportional to the savings are paid. Under this scheme, bonuses can reach up to 20 percent of wages and salaries.
The above incentive schemes represent only the first steps needed to achieve better efficiency in the sector. In addition to developing an adequate system of performance measurement, evaluation and incentives, there is a need to set up a better system to identify potential managers, train and develop them, and select the most qualified candidates.

A critical evaluation of the retention price formula indicates the following deficiencies:

1. It does not allow for revaluation of assets of the unit for the purpose of calculating the retention price;

2. The depreciation amount charged to the income statement of a unit is based on the historical book value of investments, thus giving a distorted picture of profitability;

3. The retention price increases at a significantly lower rate than that of inflation rate and as a result, the unit's revenues decrease over time in real terms;

4. The cash flow of the unit also declines in real terms over the years;

5. There is an implication of a cross-subsidization from old to new units; and

6. The system does not take into account equilibrium international prices in setting the ex-factory prices, and, therefore, it does not provide an automatic signal to inefficient plants to cease operation, if they cannot compete with imports.

In Pakistan, the Marketing and Pricing Agreement of 1982 for the Fauji plant at Sadigabad stipulates that the ex-factory price for urea will be set for a period of 10 years following the commencement of commercial operations so as to yield an annual after-tax return of 16 percent on the par value of preferred shares and an annual after-tax return of 20 percent on the common share capital, based on 65 percent capacity utilization in the first year of operation, 85 percent in the second year and 90 percent from the third year onwards. Fauji would bear the production and sales volume risk and will realize the above return only if it produces and sells the urea at the annual levels stipulated above.

In Colombia, fertilizer prices are set as follows. Ex-factory prices are fixed by the Government on the basis of the average cost of production and are revised every three months. The quarterly revision is done in view of the fact that inflation and devaluation have accelerated in recent years to over 20 percent a year. To calculate the required increase, the different components of the price are grouped into two categories: cost of raw materials and value added. The value added is increased every quarter at a rate equal to the average rate of inflation of
the country, calculated on the basis of the increase in the consumer price index. To this is added the cost of raw materials, calculated by multiplying the standard input coefficients by the last reported prices in the national (for local inputs) and international (for imported inputs) markets. Provisions are made to include all taxes paid and to take into account the effective exchange rate for imported inputs. Given the resulting average increase in prices, the industry may adjust the retail price of different fertilizers to ensure a logical structure of relative prices.

**Fixed Price Based on Internal Prices of Selected Countries** (e.g., Hungary, Yugoslavia). Prices are fixed on the basis of landed international prices or on the basis of comparable domestic prices in neighboring countries.

In Hungary, the 1979-80 price reforms established the concept of "competitive prices." Producer prices were linked with world market prices either directly through actual import prices or indirectly through specific rules and regulations. Prior to the 1979-80 price reforms, the pricing policy was based on the principle of cost plus. This system had a considerable disadvantage of protecting the domestic manufacturers from the international market, and there was no incentive for the manufacturers to innovate and modernize their plants, since any investment aimed at cost savings would have resulted in a lower ex-factory price. Since 1980, however, the fertilizer ex-factory prices have been moving freely with international prices. In Hungary about 60 percent of the natural gas requirements are met from local resources, and the rest is imported. Natural gas is made available to fertilizer plants at prices lower than the opportunity cost of gas, thus giving an indirect subsidy to the fertilizer industry, while fixing ex-factory prices based on c.i.f. import prices. The policy of tying ex-factory prices to international prices yielded domestic manufacturers an average return of 13 percent on investment in 1981. Subsequently, the sharp decline in world market prices attributable to the worldwide recession approximately halved this return.

As for retail prices, they vary with the ex-factory or import prices depending on whether the product is produced domestically or imported. If the retail prices go above the stipulated maximum, the Government subsidizes the consumer by reimbursing the distributors for the difference. The aim is to keep consumer prices at a level that encourages consumption.

In Yugoslavia, the domestic retail prices of fertilizers in the neighboring countries serve, along with international market prices, as guidelines for setting ex-factory fertilizer prices. Efforts are being made to bring the domestic prices of finished fertilizers into line with world market prices. A good feature of the Yugoslavian fertilizer price mechanism is that along with the price movements of fertilizers in the neighboring countries and in the international market, the cost of production in the domestic fertilizer industry is also taken into account in fixing the ex-factory prices. However, the ex-factory prices paid for
fertilizers reportedly do not cover the costs of production of every plant. For the most part, they have been set on the basis of production costs in plants commissioned in 1968 or before. On the other hand, new fertilizer plants were built at far higher capital costs in real terms. The share in production costs at the Fertilizer Complex Kutina 2 attributable to invested capital (i.e., depreciation and interest charges) is approximately 33 percent. This element does not affect the already domestic ex-factory depreciated plants. Periodic reviews should be made, and prices seem necessary to enable ex-factory prices to reflect these differences in capital costs. Moreover, these reviews could take into account such factors as inflation, currency realignments, high capital charges and the economic effects of the energy crisis. Recently, the Federal Secretariat for Markets and General Economics, responsible for price determination in close collaboration with Agrohemija (an association of fertilizer producers) and the fertilizer producers and users, has indicated that domestic fertilizer prices will shortly be raised to ease the financial position of fertilizer plants.

With respect to dissuading operation of plants whose long-term economic viability is questionable and to induce the choice of new investments, this price mechanism does not provide a clear signal. In order to enable fertilizer producers to assign priorities to economically justified investments and to plan for the phase-out of production units that cannot be made economic, the Government of Yugoslavia has plans to:

(1) Carry out a production cost analysis, including technical and energy audits, in all fertilizer plants in order to assess their operating and energy efficiencies;

(2) identify the measures and investments that may be required to reduce costs, and quantify the savings that may be achieved by these investments and measures; and

(3) assess the technical, financial and economic viability of the identified investments as well as the viability of the production unit after its rehabilitation.

Smoothed World Prices (e.g., Turkey). Prices are set at levels that reflect long-term average international prices, after smoothing for short-term fluctuations. In a growing industry such as fertilizers, this approach should reflect long-term marginal cost pricing for internationally efficient producers. One technique is to use a multi-year moving average of international prices. A variant is to use a smoothed international price as a reference point and to provide an incentive for local value added by shadow pricing foreign exchange savings. Another is to use the average domestic fertilizer prices in a representative sample of countries, instead of the smoothed international prices.

In Turkey, both the ex-factory prices of fertilizers and the prices paid by farmers are determined by the Government and issued by decree. In practice, these prices have been set at such levels that the
fertilizer procurement/distribution agencies (DONATIM and SEKER) purchase from domestic manufacturers usually at prices that exceed the world market (import) prices, and sell both domestic and imported fertilizers to farmers at prices substantially below world market prices. The Government compensates them for the difference, called "duty loss," which they incur in the process.

The current ex-factory formula (which has been in effect since July 1980) links the prices received by the domestic fertilizer manufacturers to c.i.f. import prices to bring the ex-factory prices of domestically produced fertilizers to a competitive level with international prices. Adjustments are, however, made in the formula to give a premium to the net foreign exchange savings resulting from domestic production of fertilizers. This aims at reducing the industry's dependence on imports by providing an incentive for domestic manufacturers to invest further in facilities that can both use raw materials and manufacture intermediate products to increase domestic value added.

Ex-factory prices are determined individually for each fertilizer plant every six months based on the average c.i.f. US$ price of comparable products imported by DONATIM. The formula used is as follows:

\[ F = [A - (B + C)] P + D + E \]

Where

- **F** = Ex-factory price (TL/ton)
- **A** = C.i.f. import price of comparable products (US$/ton)
- **P** = Shadow exchange rate determined by the Money and Credit Committee
- **B** = US$ value of direct raw materials or imports of intermediates per ton of fertilizer produced (US$/ton), calculated on the basis of the price of inventories and c.i.f. price of imports realized by the manufacturer in the period
- **E** = TL value of local intermediates per ton of fertilizer produced (TL/ton), calculated considering the manufacturer's inventories at the beginning of the period and the actual purchases (documented by invoice)
- **D** = TL value of B (TL/ton), i.e., TL equivalent value of imported raw materials or intermediates per ton of fertilizer produced. This is calculated using the actual exchange rate at the date of clearing from customs. Materials not cleared from customs at the end of the six-month period, or within 90 days after importation, are evaluated at the exchange rate of, respectively, the end of the period or the 91st day.
\[ C = \text{US$ value of imports comparable to local materials accounted for in E.} \]

This is estimated on the basis of actual imports (either by the same company or by another domestic producer of similar materials) during the corresponding six-month period, or, if there were no imports during the period, on the basis of c.i.f. world prices. Inventories at the beginning of the six-month period are taken into consideration.

A modification to the formula had to be adopted starting in 1981 to dampen the effects of falling international fertilizer prices. As the c.i.f. prices of most fertilizers (except, initially, urea and SSP) started to drop in 1981, the prices used in the ex-factory formula during the first semester of 1981 were derived, for all fertilizers except urea and SSP, from the c.i.f. prices of the second semester of 1980 in place of the actual lower import prices of the first semester of 1981. Some additional premium was also given for DAP and compound fertilizers. In the second semester of 1981 and the first semester of 1982, the same six-month lag was repeated for most fertilizers, with additional premia for DAP, compound fertilizers and TSP, and a one-year lag for urea starting from the first semester of 1982. By the second semester of 1982, the time lag was one year for all fertilizers except urea (18 months), and TSP, DAP and compound fertilizers benefitted from even higher premia. The prices used in the ex-factory formula in 1983 reflect roughly the prevailing actual c.i.f. prices at the end of 1981, i.e., about an 18-month lag on average, except for urea, for which it is even higher.

The adjustments in c.i.f. prices used in the formula are obviously justified in principle, since the purpose of linking domestic ex-factory prices to c.i.f. prices is to ensure the competitiveness of the domestic industry in the international market over the long run. The c.i.f. spot prices used normally in the formula do not reflect the long-run world prices of fertilizers (i.e., the long-run marginal cost of producing the amount needed to meet world demand). They reflect, instead, the short-term international balance of supply and demand as well as the transitory disturbances in the world market resulting from factors such as collusion among major world producers, stockpiling by large-scale buyers in anticipation of price increases, dumping of fertilizers by established firms at unduly low prices in times of low world demand, etc. There is a need to shield domestic producers from such temporary fluctuations of spot prices, which are quite large in the case of fertilizers. Otherwise investment in fertilizer manufacturing would appear as an unduly risky venture. The problem is, however, that since such considerations were overlooked when the formula was decided, subsequent adjustments of c.i.f. prices have been adopted ad hoc. Similarly, the other major controlling parameter, i.e., the shadow exchange rate, is not set according to clearly determined principles. The margin between the shadow exchange rate and the actual average exchange rate has narrowed considerably over those years.

In recent years, the selection of the two key parameters of the formula (c.i.f. import value and shadow exchange rate) has thus been guided by the need to protect the industry and ensure some profit independently.
from temporary disturbances in the world market. Additional considerations have also apparently been taken into account in this selection, such as a desire to support initial operations at some recently established plants (urea, compound fertilizers) through higher premia on the c.i.f. values used in the formula. As a result, the formula has diverged somewhat from its original purpose of linking domestic to world prices. As the selection of the two key parameters appears arbitrary to the manufacturers and, at the same time, the exact calculation of the cost elements (B, C, D, E) of the formula seems to involve some degree of bureaucratic discretion, the current system has failed to provide domestic producers with clear signals ahead of time and with enough certainty about the long-term policy of the Government regarding fertilizer pricing. More definite standards for setting final ex-factory prices would be desirable to induce producers to make new investments.

Another problem associated with the application of the current formula stems from the considerable uncertainty that prevails at the beginning of each six-month period as to likely movements in the exchange rates and prices of raw materials during the forthcoming six months. In practice, a temporary price is announced for each factory at the beginning of each six-month period. The final determination of the c.i.f. import value and the shadow exchange rate and, hence, of the ex-factory prices, is made only after the end of the six-month period, when the actual (realized) prices of raw and intermediate materials and their TL value are known, as well as the c.i.f. prices of finished products. This delay means that the manufacturers operate under considerable uncertainty even over the short term.

Free Market Pricing. Prices are determined by the free market and reflect current international border prices.

Evaluation of the Pricing System

All country participants were unanimous that their pricing systems could be refined and improve in light of the discussions at the seminar. They noted certain common problems relating to the prices: (1) they are not revised often enough to take into account changes in the prices of inputs; (2) they are based on inappropriate depreciation schedules; (3) they are based on subjective judgments about the norms for production costs; (4) they are based on low fixed rates of return or sales margins; and (5) they do not account adequately for certain costs such as transportation and distribution.

Evaluation of the Pricing System

The attached chart (p. 20) provides one overview of how different pricing systems meet the above-mentioned five objectives. Certainly, other interpretations are possible, and many were offered. For example, the free market system may not always weed out only uneconomic units—temporary abnormally low price conditions can force an otherwise economically viable firm to close. The point was also made that free market systems are not
necessarily completely free in practice. Many participants in the Seminar felt that an "auction" system could destabilize the entire system of fertilizer supply and distribution that has been established in many developing countries with considerable investments. A general comment about administered price systems was that they require large government bureaucracies and a complex data-gathering system to collect information on investment and operating costs for efficient plants in other countries, information that is used subsequently for comparison with the actual costs of domestic plants. The free market system accounts for that information implicitly.

III. HIGHLIGHTS OF THE DISCUSSIONS

The discussions at the Seminar were wide-ranging, and it proved difficult to reach a consensus on most issues. Following are some of the highlights.

(1) It is indeed possible and important to separate the design of ex-factory and farmgate pricing. Such delinking, however, has a limited degree of freedom, for both sets of prices are actually linked. In the most common case, i.e., when producer prices are higher than those charged to farmers, subsidies are needed to fill the gap between the average of the two. As lower prices encourage an expansion in the demand for fertilizer, the subsidy amount tends to increase beyond what is affordable for the government. Two obvious solutions to this problem are: (i) to increase the efficiency or productivity of the local fertilizer industry, or (ii) to raise the prices for farmers. As to increasing fertilizer industry efficiency, the discussion centered on various pricing methods and formulae and their suitability to signal inefficient plants either for closure or for modernization and rehabilitation, so that the overall cost of producing fertilizers can be reduced. On the increase in fertilizer farmgate prices, many of the country papers distributed at the seminar supported the view that raising fertilizer prices does lead to reductions in the volume of products bought by farmers. It was suggested that at a time when diverse circumstances make the elimination of most subsidies advisable, including those for fertilizers, the need for an economic assessment of the cost-effectiveness of fertilizer subsidies is of high operational relevance. As such, both sets of prices should be closely monitored, and every effort should be made to supply fertilizers to farmers at a minimum cost.

(2) Many countries seem to use one of two basic systems—cost-based and international price-based. Wide variations in these two basic ex-factory pricing systems were recognized,
but there was no consensus about the superiority of any one approach over the others. No system can be considered optimal, and the choice will depend heavily on the unique circumstances of each country and its national development strategies. Some suggestions to improve existing policies were made.

(3) In a majority of the participating countries it seemed that the ex-factory fertilizer pricing policy is least influenced by the relative cost of supplying fertilizers from domestic industry vis-a-vis imports. Rather, it seemed to be governed by the premise that domestic industry as a source of supply is preferable to imports. Among the reasons mentioned by the participants to develop a substantial local production capacity in their countries are: (i) stable fertilizer supplies are crucial for agricultural growth in general, and for food security in particular; (ii) international prices are highly volatile, making it difficult for a country to ensure a steady supply of fertilizers at stable prices to farmers; and (iii) even if imported fertilizers were cheaper than those locally produced, most of the time countries face very tight foreign exchange situations. For most, foreign exchange savings are more important than minimum cost fertilizer supplies to farmers. Furthermore, other factors such as utilization of local resources, search for self-reliance, industrial policy and regional development imperatives are always considered by governments when analyzing the feasibility of local production.

(4) Several points were made about administered pricing systems:

(i) Prices should be set with greater frequency, taking into account changes in the input and output markets.

(ii) It is important to define clearly the objectives of the ex-factory pricing system and not to confuse them with other development-related objectives. Similarly, it is important to recognize that there is more than one instrument for achieving different objectives. The key is to identify and apply the best instrument to achieve a given objective. If the aim is to increase agricultural production, intervention in the ex-factory price may not be the optimal means. Preferable alternatives might include administered farmgate pricing, rationalization of the transportation and distribution systems for timely delivery of fertilizers to farmers, strengthening the extension services that focus on soil testing and technical assistance for the proper use of fertilizers, and expansion of credit to farmers for purchases of fertilizers and other
agricultural inputs. If the objective, on the other hand, is to increase the use of a particular input such as fertilizers, the optimum intervention is a subsidy on its use, although other instruments could achieve the same objective, albeit with higher welfare costs.

(iii) If an administered pricing system at the ex-factory level is used, it must be structured so as to include incentives to promote plant efficiency, rationalization and expansion.

(iv) The country papers submitted by the participants indicate that fertilizer use is sensitive to changes in prices: steep increases in fertilizer prices either reduce the rate of growth in fertilizer use (as in Pakistan) or reduce the absolute amounts of fertilizers used (as in Turkey). There was, however, no consensus about the degree of negative association between fertilizer use and prices.

(v) It is important to review the role of production and timely availability in fertilizer consumption. In some countries, inadequate local availability and/or other factors such as an inadequate distribution system, inefficient use of fertilizers, lack of credit and similar factors could be more responsible for hindering growth in fertilizer consumption than are increases in fertilizer prices per se. In this context, it was emphasized that non-price factors such as availability, marketing and distribution systems, credit, and knowledge of fertilizer use should also be considered in developing a strategy to promote growth in fertilizer use. (Mr. Desai's paper discusses the role of non-price factors in promoting growth in fertilizer use in India).

(vi) Since very little is presently known about the relative importance of the price and non-price factors in promoting greater fertilizer use in the short as well as in the long run, participants urged more research in this area.

(5) One lead paper suggested an auction system as an alternative to the administered price systems. To provide some incentive for local production, a margin of preference (up to 15 percent) could be provided to domestic firms when evaluating domestic bids against foreign bids and for bids by local importers. Such a bidding system would introduce competition and allow a country to benefit from favorable world prices. Country representatives did not show much support for an auction system, as they feared they would not be able to protect even economically viable local plants against dumping and other unfair trade practices.
(6) The matter of international prices generated considerable discussion, with most participants concerned about two issues. One is how to use the international price as a guide for domestic fertilizer pricing, given the volatility of the international market and distortions in spot-market prices. Moreover, what is the representative international price, given hidden distortions such as tariffs and subsidies or the various controlled energy prices in different producer countries? One suggestion was to use a moving average for a period long enough to cover the business cycle. The second issue was the wide variation between the international price and the domestic prices in major exporting countries. Some participants felt that domestic prices in selected major exporting countries fluctuate less than export prices and that, as such, domestic prices provide a better guide for the administered fertilizer pricing system in developing countries. The Yugoslavian fertilizer price system is based on this price mechanism. However, at the same time doubts were raised about the usefulness of cross-country comparisons of the costs of production in fixing ex-factory prices. These doubts were based on a variety of considerations ranging from dumping and differences between domestic and export market prices to differences in the policies followed by different countries in fixing the prices of raw materials for fertilizers.

(7) Some participants believed that even in countries following the free market system, there could be conditions in which intervention might be justified, for example, when dumping was taking place or in the case of monopoly/oligopoly. Further, in periods of industrial restructuring, measures such as temporary subsidies or payments from a fund (e.g., for mothballing obsolete plants), might be introduced.

(8) Some participants emphasized the dynamism of the world and the need to review continuously the basis for a given policy and to adapt to new circumstances. Intervention in fertilizer pricing might have been appropriate in many countries several decades ago to introduce farmers to the use of fertilizers. Now farmers all over the world are increasingly aware of the importance of fertilizer use. However, in many countries, fertilizer consumption is not balanced or efficient, and it is therefore more important to increase the efficiency of the use of fertilizers through a package of improved farming practices than to increase fertilizer consumption through large-scale subsidies.

(9) When countries modify their fertilizer pricing policies, achieving a smooth transition from old to new policies is important and should be the subject of careful planning,
taking into account the overall input and output price relationships in agriculture.

(10) More attention needs to be paid to non-price factors such as adequate infrastructure for fertilizer production and distribution (e.g., power, water and transportation facilities) and improving the efficiency of fertilizer distribution and fertilizer use. Similarly, more attention needs to be paid to non-pricing instruments in achieving national objectives. These include better agricultural extension services, credit programs, dissemination of information, better transportation and distribution systems, timely delivery of fertilizer to farmers, and ready markets for foodgrains and other crops.

(11) It was emphasized that developing countries can least afford bad economic policy. Concern was expressed over the continued operation of uneconomic plants in some countries, where the employment of people in those plants is safeguarded without looking at the overall social costs and benefits. Some plants will never be competitive, even at their lowest cost of production and highest operational efficiency. There should be some absolute cut-off point at which plants are closed, probably when the economic variable costs of the inputs exceed the economic value of the outputs. Some participants argued that many administered price systems do provide signals to different plants regarding their economic viability. A related issue is how to take advantage of temporarily favorable conditions in the international market for raw materials, intermediate products and/or finished fertilizers.

(12) During the discussion on the short-run operations of fertilizer plants it was highlighted that factors such as excessive costs involved in frequent shutting down of fertilizer plants, and limited availability of foreign exchange resources, play an important role. In the participants' view, two different sets of prices are required: one set governing short-run production plants, and the other, long-run investment decisions. A unique five-year moving average of the international market price as used in Turkey may not be suitable for both needs. A couple of times the question of whether subsidies were granted to cover the industry's higher costs or to provide farmers with fertilizers at below market prices was touched on, but no conclusion was reached.

(13) It was suggested that more attention be paid to the optimal allocation of resources to different sectors within an economy. In this context, are large subsidies for fertilizer production still appropriate? Some argued that there are sometimes considerable indirect benefits from subsidies that cannot be adequately quantified. However, if
fertilizer subsidies are helping only the inefficient production facilities, the removal of the subsidy would not affect agricultural development.

(14) There was a great deal of discussion about variations in the characteristics of different plants (vintage, feedstock, technology, etc.) and how they affect the design of a pricing system. A related issue is the high capital cost of building new plants, which at times makes the real production costs of new firms considerably higher than those of many old plants, even though the new plants use the latest technology. It was pointed out that in a dynamic changing situation, this is not a significant factor for investment decision-making, as the new plant of today becomes the old plant of tomorrow, and future investments are based on the perception investors have of future supply/demand and fertilizer prices.

IV. RECOMMENDATIONS TO THE WORLD BANK

Participants suggested several topics the World Bank could address to help borrower countries optimize fertilizer production, distribution and use. The recommendations include:

- Further research and dissemination of information on the nature of the international fertilizer market, on how to deal with non-economic factors (e.g., dumping) and on how to take advantage of favorable conditions in the international market.
- Development of a formula for calculating smoothed international fertilizer prices.
- Research into improving the managerial efficiency of public sector enterprises.
- Collection and dissemination of information on the production costs of fertilizer projects financed by the World Bank.
- More research and information on non-price factors, such as rationalization of old plants and improving the efficiency of the transportation and distribution systems, as well as of fertilizer use.
- The establishment of a small consultative group for periodic exchanges of views on the fertilizer pricing systems in different countries, with particular reference to the modifications achieved.
<table>
<thead>
<tr>
<th>Objective</th>
<th>Actual Cost Recovery System (Including Bonus for Achieving Quantity Targets)</th>
<th>Actual Cost Plus System (Based on Rate of Return on Assets, Sales or Net Worth)</th>
<th>Normative Cost Plus System (Based on Rate of Return on Net Worth)</th>
<th>Fixed Price Based on Internal Prices of Selected Countries</th>
<th>Smoothed (Weighted Average) International (Border) Prices</th>
<th>Free Market Pricing (Allowing for Free Imports to Reflect Current International Prices)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. X-COST EFFICIENCY</td>
<td>No Incentive for (a) and (b), except for capacity</td>
<td>No Incentive for (a) and (b)</td>
<td>Positive Incentive to Minimize actual costs for those costs for which there are norms in the formula (specific consumptions), fixed costs (through capacity utilization), investment costs. No incentive for (b) to stop operation of uneconomic plants</td>
<td>Positive incentive to maximize efficiency and rationalize plant; unclear incentive to discontinue uneconomic plants</td>
<td>Positive incentive to maximize X-efficiency</td>
<td>Positive incentive to maximize X-efficiency on both counts</td>
</tr>
<tr>
<td>2. ALLOCATIVE EFFICIENCY</td>
<td>No Incentive to select optimal economic investment</td>
<td>No Incentive to select optimal economic investment</td>
<td>No Incentive to select optimal economic investment</td>
<td>Incentive unclear</td>
<td>Positive inducement to select optimal economic investment</td>
<td>Positive inducement to select optimal economic investment</td>
</tr>
<tr>
<td>3. FINANCIAL HEALTH AND MANAGEMENT EVALUATION</td>
<td>Negative impact on financial health; does not facilitate measurement of management performance</td>
<td>Positive impact on financial health; facilitates measurement of management performance</td>
<td>Positive impact on financial health; facilitates measurement of management performance</td>
<td>Impact unclear depending on level of fixed prices</td>
<td>Yes, if the firm is economically viable in the long term</td>
<td>No in the short term, if spot prices are low. Yes in the long term, if the firm is economically viable</td>
</tr>
<tr>
<td>4. FISCAL IMPACT</td>
<td>Positive impact</td>
<td>Negative impact</td>
<td>Positive impact as far as actual taxes are concerned - Negative impact if unconnected firms are supported</td>
<td>Impact unclear</td>
<td>Minimum impact over the long term</td>
<td>Fluctuating, with impact depending on level of spot prices</td>
</tr>
<tr>
<td>5. COMPLEXITY AND EASE/COST OF IMPLEMENTATION</td>
<td>Requires internal data - Ease of application</td>
<td>Requires internal data - Ease of application</td>
<td>Requires more sophisticated internal data - Ease of application</td>
<td>Does not require internal data - Ease of application</td>
<td>Does not require internal data - Ease of application</td>
<td>Does not require internal data - Ease of application</td>
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PART I

PRINCIPLES OF PRICING
Chapter 1

FERILIZER PRICING PRINCIPLES

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Evaluation of the economic impact of alternative fertilizer pricing systems requires an understanding of the principles of pricing. As an introduction to the seminar papers, this section provides a theoretical framework on the economic objectives of prices, the mechanisms of price determination in the free market and the distortions caused by market failures.

I. THE ECONOMIC FUNCTIONS OF PRICES

The importance of prices in an economy can be better appreciated by reviewing the most important economic functions they should perform. Regardless of whether they are determined by the forces of supply and demand in a free market, prices will be economically optimal if they are able to perform the following functions:

1. Resource Mobilization. Prices should provide adequate stimulus to mobilize an optimal amount of resources into the sector, for both the current operations of existing firms (short-term resource uses) and new investments (long-term resource uses). In response to a rise in demand for a product beyond existing capacity, prices should normally go up to increase sectoral profitability at least temporarily, so that additional investment is attracted into the sector. On the other hand, when there is excess supply, prices should be able to signal the need for contraction in the sector; normally the signal is through a drop in prices, which forces the less efficient plants to close.

2. Resource Allocation. In addition to encouraging the mobilization of resources into expanding sectors, prices should ensure that the economy's resources are optimally allocated among competing uses. In the short term, as long as firms pursue profit maximization, input and output prices should provide adequate motivation to existing firms to minimize operating costs and increase operating efficiency. In the long run, prices should ensure that resources are allocated to the most economic investments and that new investments are undertaken only if the expected economic value of incremental supplies is higher than the expected economic costs. Prices should encourage the enterprises to optimize the scope and configuration of investment projects, including size, timing, location, technology choice, feedstock used and the like.

3. Efficient Rationing. Prices should ensure that the market will be cleared of excess demand or excess supply. If prices are not
allowed to rise when demand rises or supply falls, excess demand can only be suppressed by rationing the scarce supply among potential buyers. In this case, there is no guarantee that the available goods will go to the consumers that can make best economic use of them. In fact, the result may just be "wasteful" consumption or hoarding by some segments of the economy. If, however, prices are allowed to rise, that increase in itself performs the rationing function. Only buyers who place the highest value on the product will exercise their demand; others will leave the market. Thus rationing through the pricing system will ensure an efficient allocation of resources. If, for equity considerations, the Government wishes to induce consumption by low-income buyers who may have been squeezed out of the market, an optimal pricing system will make the subsidies "transparent," so that the authorities can measure and assess the socioeconomic costs and benefits of the subsidies.

(4) Information. By providing market signals, the price system serves as a simple mechanism to guide economic agents in decision-making. Because a price indicates the rate at which one good can be exchanged for another, it facilitates decisions. The decision-maker need not incur the cost of searching for all alternatives to establish whether an action vis-à-vis a product is worthwhile. If prices are optimal, they will convey to the agent the merits of an action in a sector. The information function of prices is crucial to the operation of a decentralized economy in which economic decisions are made by individual producers and consumers. It also enables management of firms to obtain considerable autonomy in running the enterprise, a valuable spur to innovation and efficiency. In addition, it facilitates the measurement and control of management and financial performance of enterprises.

Given that prices play an important role in the mobilization and allocation of resources and perform efficient rationing and information functions of a market-oriented economy, they have considerable influence on the pattern of development of the economy. Changes in demand, in the availability and cost of inputs, in technology developments, etc., are all translated into price signals to which consumers and enterprises respond by adjusting their levels of consumption, methods of production and forms of organization. The next section reviews the mechanisms of price determination in a free market.

II. DETERMINATION OF PRICES IN A FREE MARKET

Under normal conditions, prices determined by a free market provide the signals an economy needs to function efficiently. That is, they fulfill the economic objectives mentioned in the previous section. How this outcome is achieved is discussed below.

Basic Principles of Market Behavior

The basic role of a free market in pricing was first formulated by Adam Smith (The Wealth of Nations, 1776). He described the free market system as an "invisible hand" whereby the private interests of individuals
lead to the best interest of society via the forces of competition. He postulated that the individual self-interests of similarly motivated individuals will result in competition; and self-interest and competition will result in the provision of those goods that society wants in the quantities that society desires and at the prices that society is prepared to pay. Self-interest is the driving force of the market; competition is the regulator. Without competition, a profit-hungry firm could increase prices to exorbitant levels. If it were to do so in a competitive environment, however, it would find that other firms would step into its trade. Self-interest and competition will act together not only to establish optimal prices for products, but also to ensure that producers supply the quantities of goods that society demands.

The market pricing system is, therefore, a self-regulating mechanism for society's optimal functioning. For the market to work effectively in a competitive environment, Adam Smith postulated that it should not be tampered with, since all its links need to be closed in a chain of cause and effect. The postulates of Adam Smith led to a doctrine of "laissez-faire": let the market alone so that the laws of the market will bring society to its point of highest returns.

Adam Smith's system, however, required perfect market conditions. He recognized, for example, that the market system would not operate efficiently if competition were not allowed to work. The great enemies of the system were monopoly, restrictions on imports, other barriers to entry into the market, collusion among producers, lack of information, and similar conditions. (Some of these market failures and their impact on the "efficiency" of prices are discussed later.)

Adam Smith's work provided a good insight into the role of the market and importance of self-interest (profit motive) and competition. He distinguished "market" prices, which are determined at any moment by the interaction of consumers (demand) and producers (supply), from "natural" prices, which are the levels toward which market prices move as the forces of supply and demand work themselves out over time. He postulated that the constant adjustment of supply and demand tends to produce a price that just covers the cost of bringing the product to market. He assumed, therefore, that over the long term, only the cost of production, which he took to be constant, mattered in determining "normal prices."

A more generalized understanding of the long-term determination of prices had to wait until the "marginal cost revolution" of the late 19th century. The initial impetus toward a better understanding of the dynamics of the market was provided in 1838 by French economist A. Cournot, who was the first to conceptualize demand and supply as ex-ante schedules of the "desired" relationships between prices and quantities consumed and produced respectively. He was also the first to draw demand and supply as continuous curves and to establish the concept of prices as determined by the equilibrium of the "desired" schedules of supply and demand. A basic supply and demand model is shown in Figure 1, with $P_e$ the equilibrium price and $Q_e$ the equilibrium quantity of goods supplied and demanded, as buyers and sellers interact in the market.
Figure 1: BASIC SUPPLY AND DEMAND MODEL

The formulation of a basic supply and demand model was the first step toward gaining a better understanding of the nature of the self-adjusting, self-correcting mechanism of the market. However, Cournot did not link the demand schedule to its fundamental determinants, including the concept of diminishing marginal utility (or satisfaction) derived from the use of a good by the consumer, or the concept of a diminishing marginal rate of substitution between commodities. Nor did he link the supply schedules to the concepts of diminishing marginal returns. These concepts are essential to linking the supply and demand equilibrium to the concepts of the optimal mobilization and allocation of resources. To say that prices are determined by demand and supply is of limited value without the knowledge of the fundamental determinants of demand and supply. The crucial question in understanding the determination of prices is to understand which are the major factors that determine the level and shape of the demand and supply functions and what these factors imply in terms of the optimal use of an economy's resources.

Derivation of the Final Demand for a Good

In the early 1870s, three economists, William Jevons of the United Kingdom, Carl Menger of Austria and Leon Walras of Switzerland, independently formulated the principle of marginal utility (satisfaction) from goods as a fundamental element in determining the shape of the demand function for goods. Alfred Marshall (1890) further elaborated the concept and actually derived demand curves mathematically from cardinal utility functions.

The principle of diminishing marginal utility states that the total utility (satisfaction) that an individual obtains from possessing a product rises with his stock of it, but not as fast as his stock increases. That is, an incremental unit of the good provides a utility which is lower than that provided by the previous unit. As a result, the marginal (incremental) utility curve declines, as shown in Figure 2.

Marshall derived the "normal" downward slope of the demand curve (i.e., as price falls, the quantity of the good demanded by consumers increases) from the concept of diminishing marginal utility, assuming that the prices of all other commodities are unchanged and that the marginal
Marshall established by standard mathematical optimization techniques that for the consumer to maximize satisfaction from the consumption of goods subject to a budget constraint (i.e., achieve an optimal consumption of various goods or achieve economic efficiency on demand), it is necessary that the ratio of the marginal utility of a commodity to its price be equal for all goods and be equal to the marginal utility of money. In other words, to maximize his utility from all goods, the consumer will exchange goods until the ratio of marginal utilities to their prices is equal for all goods. At this point, the marginal utility derived from the last dollar spent on each commodity must be equal. On this basis, if the price of a particular commodity were to fall, its marginal utility must be lower, too, in order to maintain the ratio constant. However, under the principle of diminishing marginal utility, the reduction in marginal utility that results from the decline in price implies an increase in the amount demanded. Therefore, a fall in the price of a good will normally increase the amount of that good demanded, if the consumer's satisfaction is to be maximized. That is, on the basis of a diminishing marginal utility, the demand curve for a normal good will be negatively sloped (i.e., as prices fall, demand increases), as shown in Figure 2.

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1/ Economic theory recognizes the possible existence of "inferior" goods for which demand may fall as a result of a drop in price, if the negative "income effect" dominates the positive "substitution effect." The present discussion concentrates on the case of "normal" goods.
From this discussion, it can be seen that the demand side of the market is economically efficient if, when demand and supply reach equilibrium, the price of the commodity and the quantity consumed are at a point along the demand curve. If the price-quantity combination were to fall outside the demand curve, consumers would not be deriving maximum satisfaction from the available goods. By way of illustration, assume prices are set by an official agency. If those prices and the quantities available are fixed at a level that does not correspond to a point in the demand curve, consumers will not be maximizing their satisfaction from the goods available in the economy. The use of the economy's commodities and resources will not be optimal. By contrast, the normal workings of a free market system will achieve this optimality.

The demand curves of individual consumers may be summed to obtain a market demand curve, provided each consumer's demand function is independent of the consumption of others (i.e., it is not influenced by fashion or other externalities). As noted above, Marshall derived the demand schedule, which gives the amounts of a good that the consumer will purchase at different prices, by assuming that several other parameters are kept constant. If these other parameters were allowed to vary, one can derive a more general demand function. If other relevant variables are considered, the demand for a good will be a function of: (1) its price; (2) the prices of its substitutes and complements; (3) the income of the consumer; and (4) his tastes. In modelling actual demand, allowance is often made for time lags in the adjustment of demand to changes in other variables. These lagged adjustments can often be captured satisfactorily, in econometric studies, by relating current demand in part to demand in the previous period.

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2/ J. R. Hicks and R. G. D. Allen introduced the concept of ordinal utilities and indifference curve analysis in the 1930s as an alternative to the concept of diminishing marginal utility to derive the demand curve. Under this alternative formulation, the assumptions of measurable and diminishing marginal utility are not necessary to derive demand curves. In other words, it is not necessary to know why a consumer prefers one product to another. The information that must be known is that the consumer has a "rank ordering" of preferences for every possible combination of commodities and that he will act consistently in his choices. From the knowledge of his indifference curves for at least two products and incorporating a budget constraint, it is possible to derive the demand schedule for the consumer. Under the ordinal approach, the necessary cardinal utility concept of diminishing marginal utility (to obtain a downward sloping demand curve) is replaced by the concept of the diminishing marginal rate of substitution (indifference curves convex to the origin). Both the cardinal and ordinal utility approaches to deriving demand schedules reach the same conclusion for economic efficiency in consumption. In the ordinal utility approach, the expression for this condition is that the "marginal rate of substitution" (MRS) between any two goods must equal the ratio of their prices.

The demand for fertilizers is a derived one in the sense that it is ultimately derived from the final demand for agricultural goods. While final commodities directly satisfy consumer wants, fertilizers and their inputs contribute only indirectly to satisfying the final consumers. No one wants to consume a ton of fertilizer directly, but consumers do demand this input indirectly by demanding the farm products that fertilizers help produce. Nevertheless, Marshall's emphasis on supply and demand as an "engine of analysis," rather than on the substantive thing analyzed, made it clear that the same analytical approach is applicable to the pricing of inputs as of final products. The price of an input is determined like any other price by the factors of demand and supply. In fact, the basic principles of price determination are no different for production inputs than for final commodities, as discussed earlier. In both cases, the most crucial question is what determines the level and shape of the demand and supply curves. The main difference is that in the determination of demand for an input such as fertilizer, the function that the user (i.e., the farmer) will attempt to maximize is more objective than the utility function of a final consumer. In fact, the farmer's objective function is in principle measurable, as are the outputs and inputs of the farm. Whereas a rational consumer will demand products so as to maximize his utility for a given input, the analogous action of the farmer or entrepreneur is to maximize the value of his crop output for a given cost level, or, alternatively, if his costs are variable, to maximize the net profit that he will get over time. The farmer is not interested in the physical output that he will get from the use of fertilizers, but rather in the extra income he will receive from the additional crop output.

As in the case of final consumers, the demand for fertilizers can be obtained from the principles of maximization of the farmer's objective function, subject to the constraints under which he will need to operate. Over the long term, the objective function that a farmer is generally assumed to maximize is the present value of his net cash flow. This value is given by the present value of the difference between gross revenues from crop sales and the costs of inputs. In addition to fertilizers, other inputs the farmer will use to produce agricultural goods include, inter alia: (1) land, (2) seeds, including high-yielding varieties; (3) irrigation water; (4) agricultural credit; (5) farm equipment; and (6) labor.

In optimizing his cash flow from sales over time, the farmer faces several constraints, including: (1) a technological constraint or production function, which establishes the limits in transforming inputs into outputs; (2) institutional constraints such as the total amount of key inputs that may be available and the amount of fertilizers that can be used for self-consumption (i.e., for subsistence crop production); and (3) price evolution constraints, that is, changes in prices over time that reflect the differences between demand and supply for the various inputs and outputs. On the basis of control theory optimization techniques, the maximization of net cash flow will generate a demand equation in which fertilizer demand is dependent on the following variables: (1) the

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4/ A similar derivation is included in E. Segura, op. cit., pp. 27-40.
level of fertilizer prices; (2) the price of other inputs (including seeds, land, water, labor, credit and equipment); (3) the price of agricultural outputs; and (4) the discount rate. Again, the previous period's demand is an operationally useful proxy to capture complex inter-temporal adjustments. It will be noted that fertilizer demand, being "derived," depends on the price of final agricultural outputs. As was the case with the demand for final consumption, if the farmers are able to vary fertilizer use only, with other factors remaining unchanged, the amount demanded will tend to decline as prices increase; furthermore, at the optimal level of fertilizer consumption, the value of the marginal product from fertilizers will equal the price of fertilizer. In other words, farmers will increase their use of fertilizer until the expected value of the last unit of crop that they get from fertilizer application equals the price of the fertilizer. When farmers are able to substitute fertilizers with other inputs, the profit-maximizing use of fertilizer will occur when the marginal productivity of fertilizer, per dollar of fertilizer used, equals the marginal productivity of the other inputs, per dollar used. This situation in turn will be equal to the expected marginal revenue from agricultural output. As in the case of final products, if prices are set in a free market by the interaction of buyers and sellers, prices and consumption levels will be set at the demand curve so as to maximize the profits that farmers will get from fertilizer use. If prices and quantities available are set arbitrarily and do not fall on the farmer's demand function, the optimization of returns from fertilizers will be obstructed, for example, if the quantity available is less than farmers would freely demand at the fixed price.

Since the demand for fertilizer is "derived," the price elasticity for fertilizers (i.e., the response in terms of fertilizer demand by farmers to a change in prices) will be governed by the following principles:

(1) The demand for fertilizer is more price-elastic the more readily other inputs may be substituted for it (i.e., the less essential it is).

(2) The price elasticity of demand for fertilizer will be larger, the larger the elasticity of demand for the final product.

(3) The demand for fertilizer will be more price-elastic, the more elastic the supply of the other inputs.

(4) The demand for fertilizer will be more price-elastic, the higher the share of fertilizer in the total cost of production.

Demand for Fertilizer Inventory Changes

In addition to the demand for fertilizer consumption, market participants also exercise a demand for increases (changes) in fertilizer inventories. This demand cannot be ignored, since it will affect the optimal equilibrium price. Inventory demand originates with three purposes: transaction, precautionary and speculative. The transaction
demand arises because of lags in the production process, the seasonality of fertilizer applications and in-transit shipments. Precautionary demand comes from the desire to avoid interruptions in use because of uncertainties in supply. Speculative demand is generated by expectations of higher prices in the future, which could be sufficient to absorb storage costs and yield a profit. All these reasons for holding inventory can be grouped into an expected utility function from holding inventory. The expected utility will, in turn, be a function of expected returns from holding inventories, which is composed of a monetary return and a convenience yield, less the cost of storage. It has been shown that the solution of the above maximization function will yield a demand for inventory as a function of: (1) the current price of fertilizers; (2) the expected difference between future and current fertilizer prices; (3) the cost of storage; (4) a risk factor given by the expected variability of future fertilizer prices; and (5) the total volume of fertilizers entering the market each year.\footnote{Ibid.}

In any period, the total demand for fertilizers will be composed of the sum of the demand for fertilizer consumption, which is determined by the parameters listed above, and the demand for inventories as established by the variables listed in the previous paragraph.

Derivation of Supply Curves

Whereas the shape, configurations and downward sloping of the demand schedule can be obtained from the concept of diminishing marginal utility of the product to the user, the upward-sloping short-run supply schedule is derived from the concept of the diminishing marginal productivity of inputs to production. That is, if, in the production process, one input is increased (and others are kept fixed), a point is reached at which the increases in production from the incremental input become smaller. In deriving short-run supply curves, it is productive capacity that is held constant. Marshall showed that a profit-maximizing firm will use a combination of substitutable inputs so that the marginal productivity of the inputs, per dollar of input, is equal for all inputs (i.e., the ratio of the marginal productivity of the input to its price must be the same for all inputs\footnote{An alternative formulation, based on isoquants, is that the optimal combination of inputs occurs when the marginal rate of technical substitution of any two inputs (defined as the ratio of the marginal productivity of the inputs) equals their price ratios.}). Based on such an optimal combination of inputs, the firm will be willing to increase its supply as long as the price that it gets for its last unit exceeds or equals its marginal cost of production (i.e., the cost of producing the last unit). What this condition implies is that the short-run supply curve of the individual firm will be given by the increasing portion of its marginal cost curve that is above the average variable cost curve. It can in turn be shown that, in a competitive market, the short-run supply curve for the industry as a whole

\footnote{Ibid.}
is derived by summation of the firms' supply curves. As in the case of demand, the optimal use by firms of inputs in the entire economy results when the value of the marginal productivity of inputs is equal in all possible uses in the economy. At that point, the allocation of resources will be optimal. The relation of the marginal cost curve to the average, average variable and total cost curves of the firm is shown in Figure 3.

**Figure 3: TOTAL COST AND MARGINAL COST**

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Marginal cost

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A. Total Cost

The supply curve gives the amounts of a product that a producer will be willing to supply at different prices for the good, assuming several other economic parameters are constant. A more general supply curve can be specified by allowing these other parameters to vary. A typical short-run supply function will specify that the supply of a good is a function of: (1) the product price; (2) the prices of the production inputs, including raw materials; (3) the state of production technology; and (4) available capacity. As in the demand case, if prices are set by the free workings of supply and demand, at equilibrium the price-quantity combination will fall at the point of intersection between the supply and demand curves, a situation that ensures cost minimization on the supply side. If prices and quantities are set by an outside agency, there is no guarantee that optimality will be achieved on the supply side of the market.

**Derivation of the Supply of Fertilizer**

As shown in the previous section, the willingness of a producer to supply a product such as fertilizer is given by the rising segment of the marginal cost curve for fertilizer production. It is assumed that the producer will endeavor to use and combine his production factors so as to minimize his cost of production. Therefore, his marginal cost curve is derived after the producer has optimized this production. If he were not to do so, the economy would not be using its resources effectively, and
economic efficiency could not be achieved. An equivalent formulation is that the fertilizer producer will try to maximize the net present value of his profits (or cash flow) given by the difference between revenues from fertilizer sales and production costs, subject to constraints similar to the ones described earlier for a farmer when he is maximizing his own profits, i.e., a constraint given by the technological production function for the manufacture of fertilizers and the prices of raw materials and inputs, together with any institutional constraints on availability. In the fertilizer industry, the two major production costs are raw materials (feedstock) in the short run and capital costs in the long run. Together they normally represent 70-85 percent of total costs. As in the case of agricultural producers discussed earlier, a fertilizer producer will maximize his profits when the ratio of the marginal productivities of the inputs (i.e., the increase in production linked to the increase in output of one unit) to their input prices are the same for all inputs, and equal to his marginal revenue.

As noted earlier, the supply function of the fertilizer producer will be given by his schedule of marginal costs, when he uses inputs in combinations so as to meet the above profit maximization condition. The producer's total cost function can be derived directly from the profit maximization condition and his production function (that is, by the relationship between output and inputs). Resolving simultaneously these two functions yields the expression for the optimal quantities of inputs required to produce a given amount of fertilizers at the cost-minimizing input ratio given by the optimality condition. These optimal amounts of inputs will be functions of the price of the inputs and the quantity of fertilizers to be produced. The total cost of producing fertilizer at the optimal profit maximization condition can be derived from this expression. In turn, the marginal cost function can easily be obtained from the total cost function by mathematical derivatives. The supply curve will be the increasing portion of the marginal cost curve. The supply for fertilizers will be a function of the following variables: (1) the price of fertilizers; (2) the price of feedstock and raw materials; (3) the cost of capital; and (4) the technological variables contained in the production function. The price of capital in turn can be expressed as a function of the price of equipment, the interest rate, the effective life of capital goods, and the expectations of future profits. Technological parameters comprise both the immediate parameters for factor substitution and, over the longer term, the pace and direction of technological development.

The first two determinants of supply listed above (the price of fertilizer and the price of raw materials) determine the operating rate of the firm in the short term, that is, the rate of capacity utilization of the industry. The costs of capital will, over the long run, influence the building of new capacity and, therefore, the level of effective capacity in the industry. The supply function therefore can also be expressed as a function of the level of effective capacity and capacity utilization. (Long-run supply relationships are discussed in more detail later.)
Mechanisms of Fertilizer Pricing Determination

As noted earlier, the price of fertilizer may be determined in a free market by the interaction of the schedules of demand (including consumption and inventories) and supply. If the market equilibrium were to take place in the absence of international trade, fertilizer prices would be determined by the simultaneous resolution of the equations in which supply equals demand for consumption and for inventory. If these equations were to be solved for the price of fertilizer, the result would be that the price of fertilizer is a function of all the variables included in the three equations discussed earlier, including such variables as fertilizer demand and supply, the prices of agricultural crops and other agricultural inputs, the prices of feedstock and raw materials for the manufacture of fertilizer, technological conditions in agriculture and industry and the like.

Equilibrium of Demand and Supply and Economic Efficiency

Although by using standard econometric techniques it is possible to estimate the relationship between fertilizer prices and the other variables listed above, the complexity of the relationships illustrates the merits of a free market system. If consumers and producers are able to act independently, then, in pursuing their best interests in a competitive environment, they will aim at maximizing their satisfaction as given by their utility functions or by the present value of their future cash flows or profits. Through the equilibrium of supply and demand, they will be able to achieve their objectives simultaneously. At these equilibrium prices, the market participants will act so as to achieve the optimal economic efficiency for the use of inputs and outputs. The free market system, when it works properly, conveys complex information about social preferences, market trends, technological possibilities and expected future conditions to both producers and consumers, and it incites them to make timely adjustments in production as well as in demand structures. These adjustments in turn help ensure minimum cost to consumers and maximum sectoral efficiency. Free markets and economic competition not only lead to dynamic responses to changes, but also generate innovative changes in the face of changing circumstances over time.

The concepts of maximization of utility and profits in the face of diminishing marginal utility and diminishing marginal return to production enabled economists to concentrate on the principles of pricing mechanisms that can achieve optimal mobilization and allocation of resources among competing uses, optimal in the sense of maximizing consumers' satisfaction. When it is said that demand and supply determine prices, it is implied that demand and supply are the channels through which ultimate factors like production cost (supply) and utility (demand) operate to ensure an optimal allocation of resources. The more perfectly markets are organized—in the sense of being more competitive—the more readily the allocation of resources comes about through the incentives and disincentives provided by the market system.
The concept of economic efficiency (also often called Pareto optimality) should be interpreted for the economy's consumption and production activities as a whole. The distribution of consumer goods among users is economically efficient if every possible reallocation of goods among consumers results in a reduction in the satisfaction of at least one consumer. Production is efficient if every feasible reallocation of inputs among firms diminishes the output level of at least one firm. In other words, output is maximized when an additional unit of a factor of production of equal quality contributes the same increment to total output in each possible use and receives the same reward in each activity. When the total Pareto optimality conditions are met in the demand and supply sectors (price = marginal revenue = marginal cost), the optimal allocation of resources is achieved, or it will be impossible to make anyone better off without making someone worse off. In a perfectly competitive economy (in the absence of external economies or diseconomies, or market failures), a voluntary exchange of outputs and inputs among the society's members will achieve Pareto optimality. In fact, this is the main theoretical appeal of the free market: freely entered exchange of goods and services in a free market always leads to an improvement towards Pareto optimality. When this optimality is achieved, the corresponding rates of product substitution of all consumers are equal, the corresponding rates of input transformation of all producers are equal, and the rates of substitution equal the corresponding rates of input transformation.

III. ELABORATION OF THE BASIC DEMAND-SUPPLY MODEL

The concept of price determination for economic efficiency, presented in the previous section, can be further elaborated in terms of (1) the effects on equilibrium of the international tradability of fertilizers; (2) the long-run effect of the price determination system; and (3) the effects of time lags in adjustment toward equilibrium.

International Tradability

Fertilizer is a tradable commodity that is widely imported and exported throughout the world. It can also be stored. For a given country, therefore, the basic supply and demand model needs to be further elaborated to incorporate these features. Total fertilizer supply will be given by current fertilizer production and current imports, plus any net reduction in inventories. Total demand will be given by current fertilizer consumption and current fertilizer exports, plus any net increase in inventories. For a given period, total supply and demand will be equal ex post.

The total market for fertilizers can be represented, therefore, as shown in Figure 4, provided that the country's supply and demand are relatively small compared to international trade. (This condition is necessary so that the international world price may be assumed to be constant.)
Figure 4: TOTAL MARKET FOR FERTILIZER

According to Figure 4A, a domestic consumer may be able to get his supplies either from a local producer (at the producer's marginal cost-supply schedule) or at the import price, \( P_n \). The consumer should not buy from the local producer at a price higher than \( P_n \). Therefore, at that point the supply curve becomes horizontal. Similarly, as shown in Figure 4B, a domestic producer will face a demand curve represented by the demand for local consumption and increases in inventory, and export demand from abroad, at the export price \( P_x \). Clearly, if he can export at price \( P_x \), he will not sell locally at a price lower than \( P_x \). As shown in Figure 5, the equilibrium of supply and demand can occur: (1) at the import price, \( P_n \), at which price \( Q_p \) is produced locally and \( (Q_t - Q_p) \) is imported; (2) at export price \( P_x \), at which price \( Q_t \) is locally produced, both for local consumption \( (Q_c) \) and for exports \( (Q_t - Q_c) \); or (3) at price \( P_e \), which is in between the export and import prices and where there is no international trade.

Figure 5: EQUILIBRIUM OF SUPPLY AND DEMAND
The difference between the import price $P_n$ and the export price $P_x$ is the cost of transporting and handling the commodity from the local area to the nearest international market and vice-versa. For a bulky material such as fertilizer, these costs can be substantial. The total transport and handling costs from the international market to a country such as Pakistan, for example, can be US$50 a ton for urea. The total difference between the import and export prices can, therefore, be US$100 a ton, which is about 55 percent of the current f.o.b. price of urea of US$170 a ton. High local transportation costs can also increase the margin between export and import prices, principally for markets located inland. In such a case, local plants serving those markets may be economically viable, if the local price is equal to or below the import delivered price, whereas they may not be internationally competitive in the sense of being able to export at price, $P_x$. Many plants in India face a situation such as this one.

**Short-Run, Long-Run and Equilibrium**

The time span over which demand and supply influence the determination of prices is also important to understanding the nature of the self-adjusting mechanism of the pricing system. Marshall was the first to point out the importance of time as the main element in the working out of the supply-demand equilibrium process that determines prices. He addressed the question as to whether prices were really a reflection of the cost of the production of the good or of the final degree of utility and satisfaction yielded by the good (i.e., are diamonds high-priced because they are hard to find or because people enjoy wearing them?). Marshall postulated that equilibrium has a different meaning depending on whether the adjustment process takes place in the short or in the long run. In the short run, the bargaining process in the market revolves around a fairly fixed quantity of goods (given by the existing production capacity of the firms). Over the long run, however, the quantity of supply is not fixed. Hence, in the short run, it is the utility of the product to the user, that is, the demand for it, that has the more immediate influence on its market price. On the one hand, if demand exceeds the fixed available supply the price will increase until it reaches the utility (demand) value of the product. On the other hand, if demand is below the available supply, the price is bound to go down until it reaches the variable costs (supply) below which producers will not turn out the product, but rather will close. Over the long run, however, as the recurring flow of supply is adjusted to consumers' demand, the long-term cost of production (including capital charges) again exerts a primary influence on prices. Long-term costs may be different from current costs (and the long-term marginal cost curve may be increasing, constant or declining). Therefore the level of demand can be important in establishing the price level at which long-term equilibrium will take place. In fact, in the short and long term, neither utility nor cost can ever be divorced from the determination of prices: demand and supply are like the blades of a pair of scissors, and it is as fruitless to ask whether supply or demand alone regulates prices to ask whether the upper or lower blade of the scissors does all the cutting. However, while both blades cut, one is active and the other is passive: (1) the utility-demand blade is the active one when the cutting takes place in the quick time span of a given market; and (2) the cost of supply blade...
is active when the cutting extends over the longer period in which the scales of output and techniques of production are subject to change.

In the short run, a firm is burdened with some inescapable fixed costs: it will, therefore, maximize its profits by equating the price it gets for its last unit to its short-term marginal (incremental) cost, provided that that price is above its average variable cost of production. Over the long run, as new investments can be made, the firm will be facing a different cost curve. In the 1920s Viner showed that the long-run average cost curve (LRAC) of a firm is an envelope of its short-run average cost curves (SRAC). In an industry where investments take place in relatively continuous and smooth amounts, the long-term average cost curve for the firm may appear as in Figure 6.

![Figure 6: LONG-RUN COSTS OF A FIRM](image)

The long-run average cost of the firm (and of the industry as a whole) may be flat, increasing or decreasing, depending on the final trade-off between opposite conditions: on the one hand, the cost-reducing factors such as increased specialization, increasing returns to scale in production, and impact of external economies of scale on input costs; and, on the other hand, cost-increasing factors such as the greater complexity of operations, increased difficulties in coordination and management, external diseconomies of scale on input costs and decreasing returns to scale in production. The shape of the long-run average cost curve of the industry will also be influenced by whether or not there is free entry of new firms into the market. On the basis of the long-run average cost, it is possible to derive the long-run marginal cost curve (LRMC) for a firm and for the industry. As discussed earlier, the long-run supply curve will be given by the portion of the long-run marginal cost curve that is above the long-run average cost. This latter condition is needed because, over the long run, no production will occur at prices that will not at least cover average cost. Over the long-run, a firm in a competitive market will expand its scale of operations to the point where the long-run marginal cost curve (above the long-run average cost) is equal to market price.

The firm will choose a plant size that will enable it to operate at the long-term optimum, at which demand (marginal revenue) equals long-term marginal costs. The logical basis for this proposition is the same as in the case of short-run maximization: long-run marginal cost shows the addition of the total cost attributable to the addition of one unit of
output, after plant size has been adjusted so as to produce that rate of output at the minimum achievable unit cost; long-run marginal revenue (LRMR) shows the increase in revenue attributable to the additional unit of sales. According to the argument used earlier, maximum profit is obtained by producing the rate of output in the plant of such size, at the point where the relevant marginal cost equals marginal revenue (price). Under a perfect market, the conditions of optimal price determination (involving an optimal allocation of resources, after firms have been able to change their plant size) are similar to those of the short run (when plant size is given).

**Time Lags in Adjustment toward Equilibrium**

When a disturbance in the market takes place, in order to restore equilibrium, prices and quantities may need to adjust to the new conditions. However, the links in the market's chain of cause and effect can be quite complex, involving economic variables in many interrelated sectors of the economy. In response to a change in one of the variables, all other relevant variables will adjust only over a given period. If the time elapsed between observations of these variables is long enough, then, in such a span, the adjustment process may spread among all the variables and sectors considered in the price-quantity mechanism. Thus changes in several variables need to be considered to understand the variation in fertilizer prices. Furthermore, equilibrium models, even though they involve various sectors, may not be sufficient for the fertilizer sector, since the supply side of the fertilizer sector is normally intrinsically in disequilibrium (or adjusting toward equilibrium). In fact, in the fertilizer production industry, large adjustments in supply involve long time lags, since it takes several years to realize new production.\(^7\) Therefore, fertilizer prices rather than quantities assume the major burden of adjustment toward market equilibrium. As a result, the industry suffers from relatively large price fluctuations over time. Furthermore, because of the limited scope for adjusting output through changes in investment in the short run, the rate of capacity utilization in existing facilities assumes part of the burden for output adjustment. The industry, therefore, has been characterized by long periods of fluctuating capacity utilization.

To summarize, in developing a model for the fertilizer industry, it is useful to specify models that incorporate lagged adjustments toward equilibrium. This condition can be achieved by specifying dynamic models under which producers and and consumers optimize their utilities, not instantly, but over long periods of time.

**IV. MARKET FAILURES IN THE FERTILIZER INDUSTRY**

As discussed earlier, the existence of monopolistic elements in competition among consumers or entrepreneurs in any market obstructs the possibility of a Pareto optimal allocation of resources. Therefore, market

\(^7\) A new fertilizer plant takes about three to four years to complete and an additional two to three years to reach full capacity.
failures, or departures from perfect competition, will inhibit the achievement of economic efficiency. In the fertilizer industry, the necessary conditions to enable a free market to operate efficiently may not be fully available. However, the absence of some conditions does not mean that a free market system should be totally abandoned. If the market failures are minor, the free market system will probably continue to be the best mechanism to achieve optimal economic efficiency. If such failures are major, it may not be so. It is, therefore, important to understand the nature and seriousness of the market failures in the fertilizer industry. In some cases, Governments could make indirect corrective interventions to offset the effects of market failures and improve the actual operation of the market. In others, the circumstances may be such that Governments may have to consider direct intervention in the form of administered prices. In these latter cases, the working of a free market can provide clues to developing pricing policies that will reflect economic efficiency.

This review of market failures concentrates on developing countries. In the fertilizer industry there, the most significant failures are the result of:

1. The limited number of buyers and sellers.
2. Limited entry or exit of firms into or from the market.
3. Increasing internal and external returns to scale in production and indivisibilities.
4. Long time lags in adjustment to market equilibrium.
5. Distortions in input prices and limited mobility of resources.
6. Imperfect knowledge of market conditions.

**Limited Number of Sellers and Buyers**

Perfect competition requires that the number of product sellers and buyers be large, so that no single one will influence prices or the supply-demand curves. Except in a limited number of developing countries, the local fertilizer industry is monopolistic or oligopolistic. Given technological constraints and significant internal economies of scale, a fertilizer plant is often economically viable only if it is large. For example, an internationally scaled ammonia-urea complex should have a capacity of 1,500 tons of urea a day, or about 500,000 tons of urea a year, to enjoy the low production costs that come with advanced technologies. However, one single plant of this size will be able to cover the individual needs of most medium-sized developing countries. With a single or limited number of suppliers, a free market pricing policy may not produce an economically efficient price. It is well-known that given free choice, monopolies will charge a higher price and produce a smaller quantity than results from competitive production. Under these circumstances, most developing countries find it attractive to control prices. The structural
monopolistic propensity of fertilizer production, however, can be checked by opening the market to international trade. Such a step enables domestic fertilizer prices to be restrained a level no higher than the import price.

Although international trade can be of assistance in moderating fertilizer prices, the reliance on international import prices has some drawbacks for the following reasons:

(1) The international supply of nitrogen is heavily dominated by the Soviet Union and a few East European countries. These countries account for as much as 30% of all worldwide exports. This supply, however, has been somewhat erratic in the past, and it appears that there have been other than purely sectoral economic reasons for the changes in supply. Export decisions in these countries are highly centralized, normally in a single agency. Criteria such as the need to improve the foreign exchange situation of the country or a desire to capture a given market have often played central roles in export policy. Furthermore, year-to-year variations in exports appear to have resulted more from overestimation of the domestic demand for fertilizers than from a deliberate attempt to commercialize their natural resources through fertilizer exports. Exports, therefore, may decline as domestic consumption grows. These factors lead to uncertainty as to long-run availability and price.

(2) International demand is also dominated by a small number of players. In fact, India and China account for a large share of international imports. Import decisions in these countries are also highly centralized and are often influenced by non-economic considerations.

(3) In the phosphate and potash industries, a limited number of suppliers have an oligopolistic supply position: the US and Morocco for phosphates, Canada and the USSR for potash.

(4) International demand is highly volatile, since it is affected by such factors as weather variations and the balance of payments in importing countries, which are primarily the less developed countries.

The large share of international trade (both imports and exports) controlled by a limited number of countries, and the inherent volatility of demand, have contributed to large annual variations in trade and large fluctuations in international prices. In fact, some of the major international price variations (such as those of 1974 and 1983) originated from abrupt decisions by a limited number of market participants. As a result, some countries such as Turkey that use international prices as the main benchmark to establish local prices attempt to smooth large short-term variations by using moving averages of international prices.
Limited Entry or Exit of Firms into and from Industry

Free markets and perfect competition require that there be free entry of firms into the industry so that new entrants will prevent existing firms from reaping excess profits. Only when new competitors are able to enter the industry will the market be able to achieve an optimum allocation of resources. In fact, next to monopolistic situations, restrictions on entry into the market can probably cause some of the most damaging market failures. In the fertilizer industry, entry into the market is normally not limited by legal barriers, in spite of the fact that fertilizers are based on important local natural resources. On the contrary, most countries have legislation to induce/attract more fertilizer production. Furthermore, the fertilizer industry is not limited by product differentiation schemes (such as advertising and brand loyalty). Fertilizers are homogeneous products that are normally sold on the basis of their nutrients. Instead, the major barrier to entry into the industry is the large size of the required investment and financing. An international scale ammonia-urea plant may necessitate on the order of US$300 million to US$500 million. Such financing is not easily undertaken in most developing countries and is a significant barrier to entry.

Increasing Internal and External Returns and Economies to Scale in Production

Where production exhibits increasing economies and returns to scale, the long-run supply schedule (given by the long-run marginal cost curve) will decline over a large range of production and can intersect the demand curve at a point that is below the average cost of production, as shown below:

Prices, therefore, will be set at the point at which supply and demand intersect, or at $P_e$. This price is not sufficient to enable the industry to recover its total cost. To do so, a price of $P_1$ is required. If the industry were to operate under a competitive pricing system, it would always incur losses. If this situation exists, the competitive free market system may need to be abandoned as a way of achieving economic efficiency; otherwise, subsidies may be necessary for the industry to operate under increasing returns to scale, probably by installing a system of dual prices that would exploit the consumer surplus (willingness to pay) of the most avid consumers.
The individual fertilizer plant indeed exhibits increasing returns to scale, but only over a range of production. As noted earlier, an ammonia-urea plant reaches its optimal size at about 500,000 tons a year of urea. Beyond this point, the returns are fairly constant. Cases of marginal costs below long-run average costs are in practice most commonly found in utilities producing non-traded outputs (such as hydroelectricity). While an individual fertilizer producer might find itself operating on a declining portion of its cost curve, there is little reason to suppose that the world fertilizer industry as a whole exhibits increasing returns to scale.

As trade in fertilizer is possible, the best solution for the individual firm may be, as mentioned above, to expand production for export. However, indivisibilities resulting from increasing returns to scale and the requirement of relatively large and lumpy investments create a problem by accentuating the short-term fluctuations in prices experienced by the fertilizer industry. In fact, the long-run supply curve, rather than being a continuous envelope of short-term supply curves, could be discontinuous, as shown below:

When demand is at the level, existing capacity may not be fully utilized, and prices may be set by the short-run marginal cost at , which may be adequate to recover the average variable costs but insufficient to recover the average total costs. Once demand expands to the limits of the capacity of the industry () , prices will rise, and firms are likely to cover all costs, including fixed costs, and to generate excess profits, with a short-run equilibrium at price . This situation will induce new capacity. After new capacity with lower marginal costs is installed, prices will tend to decline to a level such as . These large fluctuations are bound to cause difficulties both to fertilizer producers (who may be making investments on the basis of the wrong signals) and to farmers (whose income may be affected by the large fluctuations in prices).

The high capital cost and the large size of fertilizer plants have also caused distortions in international prices, as some producing countries with oligopolistic market structures have attempted to operate their industries at high levels of capacity utilization by protecting their local markets from foreign competition while exporting at prices above

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8/ Below this plant size, the capacity (Q) and capital cost (K) of plants of different sizes are related by the expression \((K_2/K_1) = (Q_2/Q_1)^{0.7}\).
variable costs but below full costs. With a secured (protected) local market, these firms, while charging high prices in the domestic market, can "incrementally" price and export to foreign markets at low cost. This practice will allow them to take advantage of economies of scale and higher capacity utilization. In fact, it is well-known that many countries in Western Europe as well as Asia have domestic fertilizer prices that are substantially higher than international prices. The problems discussed in this section, including the large fluctuation in fertilizer prices, have been major factors inducing less developed countries to implement systems of administered prices.

Long Time Lags in Market Adjustments

As noted earlier, time lags also impede the efficient working of the market. While resources respond to market signals, they may do so only after long delay. These delays in adjustment are caused principally by the long time it takes a fertilizer plant to be built and operated at capacity. Therefore, because quantity adjustments are stickier, the bulk of the responsibility for adjustment toward equilibrium falls on short-term price changes. In fact, in the past, fertilizer prices have fluctuated widely, as discussed earlier. To accommodate the supply response to a rise in price, Governments have often undertaken other policies to stimulate supply, while seeking to stabilize producer prices.

Distortion in the Prices of Fertilizer Inputs and Fertilizer Complementary Products

When the prices of agricultural crops, fertilizer inputs and raw materials (such as natural gas), and complementary fertilizer products (such as seeds, credit and water), are distorted and do not reflect economic opportunity costs, a free market system for fertilizer products will not be able to give optimal signals for economic efficiency. If distortions in complementary goods and input prices cannot be corrected or offset, a free market system will not give the desired results. Price distortions are fairly common in developing countries and are a major constraint on the use of the market for price determination. In many cases, distortions in prices are further compounded by constraints on the free mobility of resources. The removal of these distortions in other markets is a key to improving the efficiency of the fertilizer sector.

Imperfect Knowledge

Fertilizer is an essential input into the agricultural sector, which is normally one of the less advanced in most developing countries. Many farmers may have limited initial understanding of the costs and benefits of using fertilizers. Many countries have found it necessary to develop large programs of extension services and agricultural research to overcome this problem. Ultimately, even relatively illiterate farmers can gain a substantive understanding of the benefits of fertilizer use and improve their knowledge about the market. With adequate extension services

and improved market information, imperfect knowledge need not, in the long run, represent a major market failure limiting the efficiency of a free fertilizer market system.

V. FERTILIZER PRICE FLUCTUATIONS AND POLICY CONSIDERATIONS

From the discussion in the previous section, it appears that the major difficulty with the workings of the fertilizer market is related to the large fluctuations in international fertilizer prices, which are caused by a series of market imperfections relating principally to fluctuations in demand, economies of scale and indivisibilities. The fertilizer industry itself does not appear to have entry or exit limitations related to legal or institutional constraints, although a major limitation on entry is the high cost of fertilizer plants and limited possibilities in developing countries of obtaining the required financing. In fact, with respect to quantity supplies, although over the short term adjustments in quantity are stickier, it appears that over the long term, adjustments of supplies to demand have been forthcoming, albeit at fairly unbalanced rates.

Fertilizer prices have indeed fluctuated substantially in the past. Large fertilizer fluctuations remain even after "deflating" fertilizer prices by the price index of other related commodities, such as agricultural crops. Figure 7 indicates that, over the last two decades, urea prices (in 1982 dollars) fluctuated from peaks of US$310 a ton and US$520 a ton in 1965 and 1974, respectively, to lows of US$130 a ton and US$120 a ton in 1974 and 1983, respectively. Fertilizer prices have reacted sharply in the past to relatively small imbalances in supply and demand. In times of excess supply, fertilizer prices have declined and forced higher cost producers to close. When supplies have been short, prices have increased rapidly, until the resistance of buyers has forced them back. Under these circumstances, the industry has tended to operate with little or no profit for a few years and then to have reaped large profits in other years, before the cycle repeated itself. These cycles are primarily caused by surges in capacity additions followed by years of no addition to capacity. In the mid-1960s substantial capacity was installed as significant technological improvements were proven and producers rushed to acquire the new types of plants. This expansion resulted in depressed prices up to 1972, with no further construction taking place until about 1974, when prices rose substantially. This increase led to another round of expansion, although this time Western Europe did not participate significantly. Rather, major investment in capacity took place primarily in the Soviet Union and Eastern Europe.

Very few countries have allowed the domestic fertilizer industry to follow the large fluctuations in international fertilizer prices and to pass them on to farmers. Instead, they have established systems for controlling and administering prices, both ex-factory and farmgate. Farmgate prices have been kept by most Governments at levels low enough to maintain attractive ratios between fertilizer and crop prices. Fertilizer
Figure 7: UREA PRICES- ANNUAL
(US$ per metric ton, f.o.b. Europe, bagged)

Source: World Bank, Economic Analysis & Projections
Department, Commodities & Export Projections Division, July 7, 1983
prices for farmers have been kept at low levels in many developing countries, in particular, where the desire to keep food prices for the urban population down has led, in turn, to farmgate food prices fixed below their opportunity cost. When international prices have been low, ex-factory prices have been kept at levels intended to be high enough to enable producers to cover their costs and earn reasonable returns on invested capital at efficient levels of operation. By contrast, as noted above, many fertilizer exporting countries in the developed world have had a two-tier pricing system, with fertilizers for exports priced at a significantly lower level than fertilizers for their local markets. In fact, local prices in many European countries in early 1984 were about 20 percent to 100 percent above comparable f.o.b. export prices. These countries, however, have similar systems for protecting domestic crop prices. Importing developing countries with domestic production have controlled farmgate and ex-factory fertilizer prices with a view to ensuring that, on the one hand, fertilizer is provided to farmers at stable and attractive prices to encourage its use and, on the other hand, domestic fertilizer producers are encouraged to increase production.

The adequacy of the administered pricing systems should be evaluated carefully to assess their real economic costs and benefits to a country. Although price controls deal with the negative aspects of the "boom and bust" cycles of the international fertilizer industry, in many countries they have also resulted in serious economic distortions, including misallocation of resources, inefficiency in the operations of fertilizer plants, inequities, and extreme difficulties in assessing the performance of fertilizer companies. The costs and benefits of an administered pricing system should, therefore, be measured on the basis of the extent to which it satisfies the major economic efficiency objectives. As stated earlier, the price system should (1) provide strong incentives to existing firms to operate efficiently; (2) mobilize investments into the sector, if economic, or signal the closure of the existing facilities, if uneconomic; (3) allocate investment and other resources efficiently; (4) discourage inefficient consumption of the product; and (5) provide adequate signals for good financial and managerial performance by the firms.

The papers prepared by the country representatives for the Seminar illustrate the gamut of administered pricing systems used by developing countries. They include: (1) actual cost recovery systems, with bonuses for quantity targets; (2) actual cost plus profits, based on some measure of rate of return on assets, sales or net worth; (3) normative standard cost plus profits; (4) prices linked to the internal prices of selected countries; (5) prices based on international prices after smoothing of fluctuations; (6) prices reflecting estimated international long-run marginal costs; and (7) free market pricing. An assessment of the abilities of these pricing systems to meet the economic criteria of efficiency is given in the summary of the meeting's proceedings. It is evident from the discussions in this chapter that if prices need to be administered, the concept of international long-run marginal cost is an important guidepost under a wide range of conditions, principally when it is anticipated that demand will grow at a healthy pace, and that substantial new capacity will need to be installed to avoid shortages.
Given the difficulties in observing the long-run marginal cost curve for the industry, one method that has been widely used in the public utility sector is to approximate that cost curve by the "average incremental cost" (AIC) concept. This concept typically has been defined as the cost per unit of output, including the required return on capital, in a modern plant of optimal size with the "best practice technology" and with a good location with respect to markets and raw materials. The AIC is thus a measure that will change over time in relation to the impact of technical progress and economies of scale, as well as secular trends in operating and equipment costs. In principle, the AIC can offer a useful standard of efficiency for firms, although it is clear that further theoretical and statistical research in the behavior of the long-run marginal cost curve for fertilizers and in estimating the AIC for fertilizer plants is necessary.

The decision by a Government to exercise a degree of direct control on the ex-factory pricing of fertilizers should be assessed carefully, since it may involve substantial administrative burdens and may not be able to satisfy the economic objectives listed above. In fact, direct intervention on ex-factory prices can quickly produce undesirable effects that were not anticipated at the time the controls were introduced. If, however, intervention is necessary, then it should be designed to ensure that the pricing system will depart as little as possible from the efficiency conditions that a free market system can achieve. In fact, if a Government decides to intervene, it should aim at providing a systematic, forward-looking and consistent mechanism that will assist markets to behave competitively so as to fulfill their socio-economic objectives. In principle, direct intervention by Governments in the setting of prices is not necessarily the optimal way to correct distortions, even though the objective of the interventions may be laudable. The governments should explore whether indirect, non-pricing interventions in the market, such as, for example, removing or alleviating market failures, are viable and more efficient options. In addition, such fertilizer price stabilization options as buffer stocks, further development of futures markets, etc., should be explored further. These are areas in which more research may be desirable.

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Chapter 2

FERTILIZER PRICING IN DEVELOPING COUNTRIES: A MARKET-BASED APPROACH

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I. INTRODUCTION

Governments in most developing countries intervene in the fertilizer market. The ubiquitousness of intervention can be seen in the number of regional seminars and published surveys on fertilizer pricing policies and subsidies of the Food and Agricultural Organization/Fertilizer Industry Advisory Committee (FAO/FIAC) (1976, 1978, 1980 and 1983a and b). The periodic reports on the world fertilizer markets of the FAO/UNIDO/World Bank Working Group assume such interventions will persist.

This paper examines the case for intervention, drawing in part on specific intervention policies in some major developing countries. The purpose is to identify issues for discussion, although policy recommendations are also offered.

Fertilization in Developing Countries

Both the intensity of fertilizer usage in terms of nutrients per hectare of fertilized land and the extent of fertilization as measured by the ratio of fertilized area to total cropped area in developing countries are far below the levels in developed countries in general and in land-scarce countries in particular (FAO/FIAC, 1978; FAO, 1981a and b). Yet it also appears that the expected returns above costs from additional applications of fertilizers would be substantial for many major crops in almost all countries. In many cases, the returns would be substantial enough to justify taking a risk. Moreover, one very beneficial aspect of fertilizer use is the short lead-time in obtaining benefits: the increased output is apparent at the end of one crop season. Thus spending on fertilizers is attractive in comparison with medium- or long-term investments in irrigation and other means of increasing output, even if they ultimately yield similar rates of return. This is particularly so if the resources for longer term investments such as irrigation are not readily available.

It is therefore not surprising that governments in developing countries are interested in promoting the use of fertilizers. Yet it does not necessarily follow that this objective is best achieved by intervening in the free play of market forces. In particular, intervening in pricing is not necessarily the best approach, as the real cost of fertilizers at the farmgate is not always the major determinant of consumption.
Economic Rationale for Market Intervention

Traditional economic theory teaches that Government should intervene in markets only to correct for market failures or to achieve social objectives that cannot be otherwise achieved at acceptable social costs (Arrow, 1974a and b). Market failure may arise if, for example, the production technology of a commodity is subject to increasing returns to scale so that marginal costs fall over a wide range of output. If market demand is insufficient to absorb the output from an optimally scaled plant, a private producer will incur losses if it prices its output at the socially optimal level, i.e., at marginal cost. Other causes of market failure include externalities (e.g., environmental pollution), or the sale of a commodity with some characteristics of a public good, if it is not a public good itself, or problems of information and monitoring that arise because of moral hazards or adverse selection. An example of a public good is the use of a park: until the limits of congestion are reached, one person's use of the park does not reduce what is available for others. An example of a social objective is self-reliance in meeting the domestic requirements of some basic commodity such as food.

Apart from these and other static arguments for intervention, such as those based on the absence of markets for shifting risk, there are some well-known dynamic arguments based on the non-existence or imperfect functioning of capital markets, and on productivity gains through learning-by-doing, etc.

In sum, since the efficiency and optimality of non-intervention are based on what is technically known as a "complete set of contingent commodity markets" (in particular, the existence of markets for insuring against all kinds of risk), and since in no economy, developed or developing, is this condition ever likely to be met, in principle an argument can be made for intervention in almost all cases. In practice, however, the costs of intervention must be weighed against the benefits.

The costs and benefits in turn may depend on the forms of intervention, of which there are a bewildering variety in the real world. On the one hand, these include directly subsidizing or taxing production, imports, exports and consumption; establishing a sizable production capacity (if not a complete state monopoly); and/or developing import-export activities in the public sector. On the other hand, there are numerous indirect subsidies (or taxes) on the inputs of production, credits for financing consumption or foreign trade, applicability of foreign exchange rates, etc.

Once again, traditional economic theory offers some clues in a static or steady state context as to the ranking of these alternatives in terms of their social welfare impact. However, these rankings have been obtained under a rather restrictive set of assumptions and rarely include, even implicitly, the administration and enforcement costs of intervention (Bhagwati and Srinivasan, 1969). Nevertheless, even though in practice the traditional rankings need not hold and may even be reversed if the
assumptions are violated or if there are substantial administrative costs, this shift should not occur unless the departures from the assumptions are severe.

The following are illustrative of the rankings. If the objective is to raise the output of a commodity above its free market level, the optimum intervention is to offer a production subsidy, even though input subsidies, import tariffs and consumption will also raise output. If the objective is to increase the use of a particular input such as fertilizers, the optimum intervention is a subsidy on its use, although, once again, other instruments could achieve the same objective, albeit with higher welfare costs. Under conditions of a natural monopoly, public regulation of private production may be just as good or a better alternative than public production.

Whatever the objective and the optimum policy of achieving it, implementing the intervention in a constantly changing world is not simple. One major problem with public intervention is that it often conflicts with private incentives and gives rise to evasions and leakages of various kinds. Another is that intervention relative to one item is complicated because producers often produce more than one good and certainly use more than one input, while consumers require more than one product, some of which may be substitutes, while others complement each other. Intervention policies have to take into account the possible spill-over effects on these other goods.

Some of these issues are addressed routinely in the literature on the economics of regulation (Stigler, 1971; Posner, 1974). Unfortunately, the theories presented there appear to be of limited relevance to fertilizer pricing policies. (One good source for a more general discussion of price policies in economic development is Meier, 1983.)

In analyzing the economic considerations involved in choosing an intervention, a good starting point is the problems posed by the nature of the fertilizer industry in a large country such as India. In India, the fertilizer plants are located or proposed to be located at sites with different levels of infrastructural development. Further, plants that come on-stream at different times use different feedstocks, in part reflecting the prevailing and projected future prices of feedstocks. There is, for example, a plant that produces ammonia using hydrogen obtained from the electrolysis of water, though a decision has been made to change its feedstock to fuel oil. This plant was built at a time when a large hydroelectric project was completed, and it was believed that other demands for electricity would not exhaust its output for a long time. That belief was soon belied.

In addition to plants being of different vintages and using different feedstocks, some are in the private sector, some are in the public sector, and one or two are owned by a farmers' cooperative. Even privately owned plants, let alone public sector ones, depend more on debt than equity in financing their investment, debt that is held by publicly owned term-lending institutions. Not surprisingly, another issue is that
the demand for fertilizers, while not absent in any part of the country, is (relatively) concentrated in a few regions. They are the ones in which large doses of fertilizers per unit of land are economically very attractive because of the availability of irrigation and a cropping pattern in which fertilizer-responsive, high-yield seed varieties dominate. It must also be mentioned that India still imports a substantial volume of fertilizers, despite a very rapid growth in domestic production.

The nature of the Indian fertilizer industry creates a serious problem for policy-makers: how to formulate a policy that addresses simultaneously (1) the diverse ownership, financing and management patterns (private, public and cooperative); (2) a cost structure that involves plants of different vintages, technologies and locations; (3) a geographically diversified, yet somewhat regionally concentrated, pattern of demand; and (4) the mixture of domestic production and imports. Within the context of those considerations, the policy needs to ensure that the right (from a social point of view) amount is produced by each plant, that appropriate returns over costs accrue to producers, assuming efficient operations, that the right amount is imported, and that farmers are assured of the right amounts at the right prices and, above all, at the right times and places (fertilizers that reach the farmer when the growing season is nearly over are not much use). In short, the policy should ensure productive efficiency and distributive equity.

A good point of departure for analyzing interventionist policies is the likely outcome of not intervening, assuming the fertilizer markets are competitive. In such a world, each active demander will be supplied by some source at a delivered cost (production plus transport and distribution costs) no higher than that of any other source, domestic or imported. Each supplier will realize the same return at the margin from sales to different demanders and will obtain no higher return from selling to those to whom he is not currently selling.

In such an equilibrium, some demanders could be priced out of the market in that their demand prices (the highest price at which they would enter the market with positive demand) are below the supply prices (the lowest price at which a positive supply will emerge) from any source. Some suppliers could also be priced out if their supply prices were above the demand price of any demander. They would then have to close down. Similarly, some suppliers might realize a price above their unit variable costs but not their total costs; in the long run, they, too, will have to close. On the other hand, suppliers who realize in equilibrium a price in excess of total unit costs will have incentives to create additional capacity. In such an equilibrium, the price structure indicates the appropriate costs of meeting dispersed demands, and also signals which plants should be shut down immediately or in the long run and in which locations technology/capacity expansion should take place. Since supplies can be purchased from abroad (i.e., imports) or sold abroad (i.e., exports), optimal use of foreign trade is made in an equilibrium.

If the non-intervention equilibrium is deemed socially unsatisfactory for one or more reasons, there may be an immediate and powerful argument for intervention. For instance, if land distribution is
concentrated and agricultural tenancy widespread, small farmers and poor tenants are likely to be priced out of the fertilizer market. So might be the farmers who inhabit remoter regions or those growing crops of low market (but high social) value. Intervention may be desirable here. Another instance is where effective demand for fertilizers may be low because of the farmers' lack of experience with high levels of fertilization. It may be preferable to induce farmers to use fertilizers at a greater intensity than would occur at the non-intervention equilibrium so that they acquire experience and future demand is enhanced. This "promotional" argument involves an economic externality: current prices and intensities of use induce outward shifts of fertilizer demand in the future that are external to the decision-making and informational environments of individual suppliers. Another situation might involve "too many" imports of fertilizers at the non-intervention equilibrium.

Whatever the cause of dissatisfaction with the free market, intervention should not seriously dilute the desirable aspects of the non-intervention equilibrium. In particular, the prices that farmers pay should not depart too much from the social costs of supplying them, and the pattern of production and distribution should be efficient (retaining producer incentives and avoiding cross-haulage, among other things). Further, in the case of a "price-taking" economy, i.e., an economy whose foreign trade is too small to influence world prices, the domestic price structure should reflect world prices.

II. THE FERTILIZER INDUSTRY AND TECHNOLOGY IN PERSPECTIVE

The use of chemical or mineral fertilizers in crop production has grown rapidly since World War II--total consumption of nutrients rose from around 15 million tons in 1950 to an estimated 114 million tons in 1981-82. In 1950, developing economies accounted for less than 10 percent of world consumption and production; by 1981-82, they and the Asian centrally planned economies accounted for about a third of world consumption and a quarter of world production.

Similarly, international trade in fertilizers has grown rapidly. In excess of 33.5 million nutrient tons in 1981-82, international trade reached more than 28 percent of the world's production of 118.9 million nutrient tons (FAO, 1983; Sheldrick, 1982 and 1983b). That a sizable proportion of world output is being traded in the international markets is very important. It means that a limited domestic market need not prevent the exploitation of economies of scale in production. It also means that government subsidies should not be required to cover losses incurred on sales at marginal costs below average costs. A possible exception would be countries located so far from the markets that transportation costs preclude exports. Strong world trade could lead some countries to consider relying entirely on world markets. However, in light of the fluctuations in world market prices, an argument can be made for some domestic capacity, particularly in countries with appreciable demand. The technology of fertilizer production (particularly nitrogenous fertilizers) exhibits some
increasing returns to scale, although, as just argued, this fact per se need not necessitate government intervention. However, if the returns were to increase indefinitely with scale (rather than up to a certain scale and stop increasing thereafter), certain issues relating to the optimum size and technology of plants, when and where to build them, and how to dovetail domestic production and foreign trade will arise. These issues have been analyzed in a classic study by Manne (1967) and later by others. Production of nitrogenous fertilizers, for example, is energy-intensive, requiring as inputs natural gas, heavy fuel oil, coal, naphtha or even electricity. As such, energy costs have an important influence on the cost of the final product. A plant's location also affects costs, since the industry entails the transport of heavy materials, both inputs and outputs. For a plant producing 1,650 tons of urea a day using natural gas (at a cost US$3 per million British thermal units), the costs of locating at a well-developed site with adequate infrastructure could be about 30 percent lower as compared to a remote location. A cost advantage of the same order pertains to locating triple super phosphate plants at developed sites (Sheldrick, 1983a).

Thus, two major factors in the cost structure of the nitrogenous fertilizer industry are the costs of capital and of feedstocks. These costs have changed over time, reflecting changes in technology as well as in feedstock prices. The development of the high pressure compressor technology has enabled the construction of ammonia plants of much higher capacities (and hence lower unit costs). Because natural gas, which is cheaper compared to naphtha, has been relatively plentiful, most recently built and planned facilities use it as the feedstock. Indeed, some countries (for example, the Republic of Korea) are phasing out their naphtha-based plants rather than convert them (at substantial investment cost) to use other feedstocks such as coal. Another factor may be that even though cost-reducing technological changes have been taking place, they have been more than offset by the relatively higher inflation in equipment costs.

Supplies as reflected in the cost structure (short- and long-run) of the industry are one of two determinants of fertilizer prices, the other being demand. In the last two years, supplies have been relatively plentiful because of a temporary excess in capacity and a slack demand, the latter attributable in part to the recession in the major industrial countries as well as to bad weather in some places. The result has been a relatively low export price—around US$130 per ton of urea in July 1983 as compared to the long-run equilibrium price of US$300 per ton, as estimated by the World Bank. According to FAO/UNIDO/World Bank Working Group (1983), excess supply is likely to persist in the world fertilizer markets until 1987-88. As such, the trend of a falling price may not be reversed in the near future.

Forecasts of price trends are usually based on forecasts of demand and supply that assume away short-run demand and/or supply shocks. Such shocks, whether the result of droughts, declines in crop prices because of recessionary conditions or disruptions in supplies, can produce
price fluctuations around the trend forecasts. Figure 1, reproduced from FAO/UNIDO/World Bank Working Group (1983), shows the exceptionally steep rise in prices after the first oil shock in 1973, and the considerably less steep rise at the time of the second oil shock. In current US dollars, the price of bagged urea (f.o.b West Europe) reached a peak of about US$400 per ton in the second half of 1974, fell to about US$120 in the middle of 1976, then rose to about US$200 at the end of 1979, only to fall to about US$130 in July 1983.

Barring the two peaks, the price path was not that volatile. Indeed, if, instead of using current US dollars, the prices are measured in real terms by deflating nominal prices by some suitable index for crop prices, the fluctuations probably smooth out. Whatever the case, the perception that world prices are volatile has a bearing on national price policies, as discussed later.

III. FERTILIZER PRICING IN PRACTICE

Developing countries have adopted a range of intervention policies, some of which are examined here in terms of their purported objectives and the desiderata put forward in Section II. According to the Food and Agricultural Organization/Fertilizer Industry Advisory Committee (FAO/FIAC, 1978), the objectives underlying the use of fertilizer subsidies in developing countries are to: (1) promote initial use by innovative farmers; (2) encourage efficient use; (3) stimulate production of specific crops; (4) aid selected development projects, such as regional development; (5) sustain agricultural development by cushioning farmers against unfavorable price movements; and (6) reduce concentration (and inequalities) in the distribution of farm income.

According to the World Bank, of these six objectives, the most basic is to ensure that fertilizers are available to farmers at stable and attractive prices to encourage increased agricultural production through greater fertilizer use, while at the same time ensuring that fertilizer producers obtain a reasonable return on their investments while increasing production efficiently. In light of the policy rankings suggested by economic theory, it would seem that a fertilizer subsidy policy is not the first best policy for achieving most of these objectives. While it is first best for increasing fertilizer production (or consumption), that is true only insofar as that objective is the end in itself. It is not true in terms of agricultural production, for which a crop price subsidy is better, or of the distribution of farm income, for which income transfers are better.

Yet fertilizer subsidies are ubiquitous. The reason must be either that this policy is only one of a package of policies addressed to various objectives, or that (once) the administrative and other costs of alternative policies are identified, the subsidy policy outranks the others in achieving each of the above objectives. However, there is no solid empirical evidence this is the case.
Figure 1:
Export Prices for Some Major Fertilizer Materials
(US dollars per metric ton)

Note: The double lines indicate the price ranges for each product.

November 1975 to June 1982 - based on information obtained from various sources.
Broadly speaking, government intervention can be directed in the first instance at (1) producers, (2) consumers, (3) importers and exporters, and (4) domestic distributors, inclusive of transporters and wholesale and retail traders. As mentioned earlier, it is useful to distinguish between direct taxes or subsidies on the activities of each of these groups and indirect ones (FAO/FIAC, 1978). An ad valorem subsidy on production, that is, a payment to producers equal to a proportion of the price they realize from the market per unit of production, is a direct subsidy. On the other hand, a subsidy on the cost of any input used in production (labor, materials or interest charges on short-term credit and long-term debt, etc.) is indirect. Similarly, a purchase subsidy accrues directly to the consumer, while an interest subsidy on credits used for purchases is indirect, and so on. In countries where the government engages directly in production or foreign or domestic trade, subsidies (or, for that matter, taxes) could take the form of absorbing through the budget any losses or profits from production or trade.

Whatever their form, subsidies have to be financed (and any revenues generated by taxes have to be spent). That financing (or expenditure) will have macroeconomic effects, particularly if it is a significant portion of the budget. Another issue is that the ultimate incidence of the subsidy (or tax) is not easily located. While neither the macroeconomic impact nor the ultimate incidence are discussed here in detail, one related point must be made. By regulating producer and consumer prices simultaneously, a government may hope to control the impact of the subsidies on its budget (for instance, the impact will be zero if the government decrees that producers sell at a specified price to consumers). However, in reality that measure merely shifts the burden of the subsidy and does not eliminate the macroeconomic and incidence effects.

In large countries in which the production plants, ports of entry for imports and demand are widely dispersed, the spatial distribution of prices has important implications for efficiency (Scherer, 1980). In such situations, a government has several policy options. At one extreme is the so-called "postage-stamp pricing," in which consumers, regardless of their location, are charged the same price. At the other is the pattern that will emerge in the absence of intervention, assuming the industry is competitive. A third policy is some version of base-point pricing, in which prices are quoted free on board (f.o.b.) at set locations, with consumers bearing the transportation costs from those locations to the point of use and producers bearing the costs from their production plants to those locations. This system does not necessarily mean that, in a case where a consumer at location A buys at price P quoted f.o.b. at location B from a producer located at C, the fertilizers move from C to B to A. All it means is that the consumer pays p+t, where t is the transport cost per unit from B to A, while the producer realizes p+t-t', where t' is the transport cost per unit in delivering to A what is produced at C.

Where there is uniform pricing, the consumers located close to the sources of supply implicitly subsidize those located far away, since there is no market incentive for producers to supply remote consumers. To ensure remote consumers are supplied, a government may need to intervene in
producer pricing. A related situation is where there are both private and public enterprises. Here the private producers may ignore the remote customers, while the public enterprises, being government-owned, have to supply them and therefore incur higher costs. In this case, one set of consumers does not subsidize the others. Rather, the positive difference between the price paid and the minimal cost of supply for favorably located consumers accrues to the private producers as additional profits, while the corresponding negative difference in the case of remote consumers lowers the surplus of public enterprises. A government might then choose to set the producer price as well as the consumer price. However, since the return to the producer depends only on the producer price, and since the consumer pays the same price regardless of the source of supply, this approach blunts the incentive to minimize the costs of transportation and distribution. Another problem with uniform consumer pricing is that additional interventions are required to achieve supplementary objectives, such as promoting fertilizer use in particular areas, on particular crops or among particular groups of farmers.

Base-point pricing has its own set of problems. However, these are not discussed here, as this system is not prevalent in any developing country with respect to fertilizer pricing.

In terms of efficiency of production and investment in the fertilizer industry, any pricing policy has very important implications in terms of producer prices and returns on investment. At one extreme is the policy in India, which specifies a price that varies across producers. This price is computed in such a way as to yield a uniform rate of return (after taxes) on the producer's equity in the production facility, assuming a capacity utilization of 80 percent and consumption of inputs according to specified norms. In principle, this policy rewards producers who exceed 80 percent capacity utilization and save on inputs relative to the norms, and penalizes those which do not. However, by yielding a uniform rate of return, this system provides no signal as to which plants ought to be expanded and which ought to be phased out. The plant that is costly to operate for reasons of uneconomic scale, unsuitable location or expensive feedstock gets the same rate of return on equity as the plant that is much more economical, as long as it achieves 80 percent capacity utilization and meets the input norms. A further problem is that an investor contemplating a new facility receives an almost perverse signal: plant costs do not matter as long as utilization and input norms are met or improved on. Some observers believe this feature is an incentive to build "gold-plated" plants.

One way to blunt the possibility of gold-plating is to revise the capacity utilization norms (presumably upwards) on the basis of achieved levels of utilization. However, that policy blunts the incentive to improve capacity utilization. What is needed is a scheme that punishes gold-plating while rewarding improvements in efficiency that increase capacity utilization.

The Indian producer-pricing formula has some of the features of the cost-plus contracting characteristic of the defense industries in developed countries, although, as discussed above, it builds in some
incentives for cost-savings. (The Egyptian producer pricing scheme also appears to compensate producers for unit costs.) One argument put forward in support of India's scheme is that it avoids problems like gold-plating by having a licensing authority determine plant size, location and technology. To the extent that the authority makes decisions on the basis of social (rather than private) costs and benefits, the producer-pricing system can ensure that private producers of fertilizers alone do not bear the burden or reap the benefits of what presumably is beneficial to the economy as a whole. In other words, by transferring the deficits or surpluses of pursuing the producer-pricing scheme to the general budget of the government, society at large, and not just the fertilizer producers, bears the burden or derives the benefits. On the other hand, if the licensing authority's decisions are not socially optimal, the pricing scheme merely ensures that producers are not penalized for the authority's bungling, while society at large pays for it.

Another, not particularly desirable, feature of producer-pricing schemes of the Indian type is that the prices allowed domestic producers are not influenced by the prices in the world markets. Since many developing countries import (or export) very small volumes relative to the world trade in fertilizers, their trade has a negligible influence on world market prices. It is, therefore, reasonable to assume that world market prices represent the true social opportunity cost of fertilizers for these countries (Little and Mirrlees, 1974). As such, world prices should play a crucial role in determining both the levels of capacity utilization and investment for both expansion of old or the construction of new plants.

Clearly, world prices should be allowed to influence domestic producer pricing. However, it is sometimes argued that because of the perceived fluctuations in world prices, linking domestic and world prices creates a riskier environment for investments. This argument has pitfalls. It is not fluctuations per se that introduce risk: if the path of future prices is correctly anticipated, there is no investment risk whether the path is smooth or fluctuating. Only when the forecast of future prices is subject to error does risk arise. Nor is forecasting world prices subject to greater error than forecasting domestic prices where the domestic market is delinked from the world market.

A sensible proposal is to link domestic producer prices only with the medium- and long-term trends in world prices, so that every fluctuation around these trends is not automatically reflected in domestic prices as well. Some countries do allow producer prices to follow the world market. Hungary has tied its producer prices to world market prices presumably because it is not a large enough exporter to affect its own export prices. The Turkish pricing formula also allows world prices to influence domestic producer prices, as discussed in greater detail in Section IV.

The problem of producer pricing obviously does not arise in countries with no current or planned domestic production. However, all countries face the issue of consumer or farmgate pricing. As argued

1/ The fact that deficits or surpluses accrue to an earmarked fund confined to the fertilizer industry need not weaken this argument.
earlier, the prices that farmers pay should not depart too far from the social costs of supplying them. This in turn means that farmgate prices should reflect the opportunity costs as represented by world prices. Again, stability can be achieved by linking domestic prices to the medium- and long-term trends in world prices.

There are other issues of varying degrees of importance in different contexts that are worth noting in broad terms. One relates to the desire to place a wedge between producer prices and consumer or farmgate prices. There are many ways to impose the wedge between these two prices, and then between each of them and world prices. That is, many producer or consumer price policies can be implemented at different points; the policies include direct subsidies to consumers, producers, importers, traders and transporters, or some combination of these. Many countries do intervene at more than one point (FAO/FIAC, 1978, Appendix). Again, economic theory provides criteria for ranking the alternatives, as discussed already. However, there are many other practical matters to consider relating to the circumstances in each country; they include administrative convenience, minimizing the leakage of benefits of subsidies to groups other than the intended ones, etc. All these influence the choice of intervention.

So far, no distinction has been made among different primary fertilizers. A second issue involves the choice of subsidizing the production or consumption or trade of some nutrients and not others. For instance, if it is believed that farmers use relatively less phosphatic (or potassic) than nitrogenous fertilizers, the government may subsidize the former and not the latter. However, under certain circumstances, this approach creates problems from the point of view of production. Assume, for example, that a private firm produces many of the fertilizers, with some production costs being common. Moreover, as is sometimes the case, it is the only firm producing one or more of these products (very often because the government has licensed only enough capacity to meet planned demand). Assume, further, that competition from imports is restricted through import controls. On the other hand, a large number of firms produce other goods (and/or unrestricted imports are allowed). In this situation, regulating the producer price of the monopolistically produced product raises a number of difficult problems (Braeutigam, 1979). Again, because the fertilizer industry is not a natural monopoly (arising from technological considerations), and monopolistic or oligopolistic tendencies can be kept in check by unrestricted imports, these problems are not discussed here.

There is a separate set of issues connected with foreign trade. (1) Can some countries (e.g., India and China) that account for a significant share of world imports of fertilizers exercise some market power to reduce their import prices? (2) On the other hand, are some of the major exporters already exercising market power to raise their export prices by behaving oligopolistically? (3) What is the role of long-term contracts as well as buffer stocks, given the observed fluctuation in the spot market prices of fertilizers?
Economic theory (particularly that derived from recent work on the theory of industrial organization and foreign trade) helps in analyzing some of these issues. For instance, if the decline in India's imports of fertilizers in the last couple of years did in fact depress world export prices, then India could exploit the implied market power through an optimum tariff. Moreover, if storage losses and inventory holding costs are not excessive, it could use a combination of domestic production, inventories and foreign trade to take advantage of world price fluctuations. However, far more needs to be known about the realities of world trade in fertilizers and of the costs of information and decision-making before relevant policy conclusions can be drawn.

Finally, it is worth touching on the issue of establishing production capacity in the public sector. In theory, many of the objectives achieved by public sector production can also be achieved by other means. For instance, private producers may be reluctant to invest either because the anticipated returns fall short of the cost of capital or because the perceived risks of investing are too high. Here the government can subsidize the capital costs and provide some form of insurance against losses through guaranteed purchase prices for outputs or for supplies of inputs at fixed prices, for example, thereby inducing private producers to invest. Similarly, through appropriate tax write-off policies, the government can underwrite the teething costs associated with new technology.

Presumably, many governments find it more expedient and less costly to establish public sector production than to subsidize private investment. Whatever the case, even with public sector facilities, it is essential that investment costs be minimized and operations be efficient. Unfortunately, neither condition can be taken for granted. A recent study (Gupta, 1982) found that the total factor productivity in public sector fertilizer plants in India averaged 37 percent of that in the private sector during the period 1969-70 to 1976-77. However, the rate did improve to 71 percent when allowance was made for differences in feedstock and the additional expenditures by the public sector for staff amenities and workers' welfare. Further, if the comparison is restricted (inappropriately) to the best performing units in the two sectors, there is no difference in total factor productivity. On the other hand, another method of estimating productivity differences using a Cobb-Douglas production function showed that public sector units were operating at 43 percent of the efficiency of private sector units, even when allowances were made for feedstock differences, etc. (Gupta, 1982). The author attributed the relatively low productivity of public sector units to the "pioneering role played by the public sector in the development of fertilizer industry and indigenous fertilizer technology" (p. 185). However, the author did not examine whether the same "pioneering results" could have been achieved at a lower cost through other means.

This issue apart, in India the vagaries of electric power supply, railway transportation and coal supply, all of which are in the public sector, affect the efficiency of operations of all fertilizer plants, both public and private.
IV. PRODUCER PRICING OF FERTILIZERS: SOME ALTERNATIVES

An important objective of intervention in the fertilizer markets is to ensure that farmers are supplied efficiently. Here it is assumed that the prices farmers pay in different locations are set by the government, presumably reflecting social objectives regarding fertilizer use.

One way to achieve efficient supplies is for the government to invite both domestic producers and importers to bid for the right to supply each market, with the bid to consist of a delivered price. The government would then compensate the supplier for the difference between the accepted bid price (presumably the lowest among the bids, other things being equal) and the sale price it has set for farmers (the assumption being that the sale price to farmers will be lower than the likely minimum bid).

For this scheme to be successful, there should be no collusive bidding. Moreover, if there are any import or exchange controls, importers should be assured of at least enough foreign exchange to fulfill their tenders. Provided there is a sufficient number of domestic producers and importers who actively bid, and with assured foreign exchange, collusion is unlikely to be significant.

While the theory of auctions cannot be discussed in detail here, a few words are in order to explain why the scheme leads to efficiency in production and distribution. Clearly, bidders have every incentive to quote a price near the minimal cost of supplying a particular market—any higher bid will permit another supplier to underbid them. Since the price quoted is a delivered price at the market, presumably total costs, inclusive of the costs of production and the trade and transport margins, will be minimized. This system also generates the right signals for investment in the industry, assuming no investment licensing by the government. Given that importers also bid, if a tender by a domestic producer is successful, the implication is that the supply price is lower than that which is bid by the importer based on the world prices of supplies. As such, domestic prices are likely to move with world prices. Further, since the realized rates of return depend on successful bid prices rather than being exogenously specified, as in the Indian producer price policy, producers get correct signals as to which plant to expand, when to contract and where to invest, and so on. Where there is government licensing, the authority should use the information on the returns on investment in the successful bid prices to determine its licensing policy.

One practical question relates to the influence of distortions in other markets and of social objectives that affect the costs of domestic producers but not of importers. For instance, a social objective may be the development of a backward area by establishing a fertilizer plant there. To avoid penalizing producers for the costs of meeting this objective, costs which they will include in their bid, the government should compensate them for the minimum socially necessary costs. Similarly, if tariffs on imports of machinery or feedstock or other taxes
and subsidies or distorted exchange rates affect the costs of bidders differently, the distortions should be offset to the extent that they are not socially optimal. For example, if a country has some market power in the purchase of fertilizer machinery from foreign suppliers and it exploits that power by imposing an optimum tariff on machinery imports, that tariff should not be offset. On the other hand, if a price-taking country has imposed a tariff on machinery imports, the tariff should be offset. The offset need not take the form of duty rebates to domestic producers. Instead, a wedge in favor of bids by domestic producers versus those of importers equivalent to the tariff disadvantage will suffice.

A second question relates to the impact of fluctuating world prices on the bidding scheme. No special allowance for fluctuations is needed to the extent that decisions to invest in domestic production have been taken either on the basis of correctly anticipated future world prices or if there is no differential risk involved in foreign trade because of errors in price forecasts. On the other hand, if import prices are low because of dumping or similar situations, appropriate adjustments should be made in comparing the bids by importers and domestic producers.

The Turkish price formula incorporates the above considerations. The ex-factory price allowed to a domestic producer there is:

\[ AP + B(O-P) + C(O-P) \]

where

- \( A \) = The c.i.f. landed cost of final product per unit,
- \( B \) = Traded raw and intermediate materials,
- \( C \) = The foreign exchange equivalent of non-traded inputs,
- \( O \) = The official exchange rate, and
- \( P \) = The shadow exchange rate.

It follows that if there are no distortions, i.e., if \( O = P \), the domestic producer's bid is in essence being compared with the true import cost \( AO \). If there are distortions, imports are valued at their true social cost, \( AP \), and the distortions imposed on domestic production costs are explicitly allowed for. However, implementation of this formula requires knowledge of the shadow exchange rate as well as of the input structure of the industry. Unfortunately, experience in computing the shadow exchange rate using some sort of economy-wide model suggests it is volatile and not very robust to changes in structural features and the data base of the model. This volatility may cause unfortunate fluctuations in incentives.
V. TRANSITION TO A FREE MARKET IN FERTILIZERS

It is argued above that the case for eliminating intervention in the fertilizer markets is strong. However, just as the longstanding and strong case for free international trade has been largely ignored, it is unlikely that free fertilizer markets will come about very soon. Part of the reason is that such a change will require painful adjustments on the part of producers, farmers and the consumers of agricultural products. The hope is for a gradual move toward free markets, with the period of adjustment stretched over a longer of time.

In assessing the burden of adjustment, the impact of changes in fertilizer consumption and agricultural production appear to be more significant than the changes in fertilizer production. The reason is that the fertilizer industry is not labor-intensive, and any reduction in domestic production because of a gradual elimination of production subsidies is unlikely to affect employment significantly. Hence, it is hoped there would be no serious political resistance.

As to the impact on consumption, use of nutrients does not depend just on fertilizer prices (relative to crop prices). Other factors are also important, such as the availability of (1) adequate soil moisture through irrigation or assured precipitation, (2) fertilizer-responsive crop varieties, (3) agricultural research and extension services that generate and propagate fertilizer-responsive varieties appropriate to local agronomic environments, and (4) credit and crop insurance. Any progress in these areas would mitigate any adverse impact from the gradual elimination of consumer subsidies.

It is important to understand how non-price factors influence the empirically estimated price elasticities of demand for fertilizers, a complicated question. Grilliches (1958) estimated that the short-run elasticity of demand for fertilizers in the United States was -0.5, the long-run elasticity -2.0. Using the same methodology, Timmer (1976) found a wide range of long-run elasticities for Brazil, India, Japan, the Republic of Korea and the Philippines—from -0.34 to -5.63 (with an average of -2.0). Based on three different sets of data (aggregate data for 10 Asian countries, and time-series and cross-section farm level data for Laguna, Philippines), David (1976) found the same elasticity of -0.9 in each case, a surprising result. When non-price factors were held constant as prices changed, the elasticity changed to -0.3. Desai (1982), using aggregate time series data for India, estimated elasticity to be around -1.0. These elasticities, together with crop-yield responses to fertilizer use and the initial level of real fertilizer prices (and hence, initial consumption), determine the likely fall in consumption as subsidies are withdrawn. As to the real price of fertilizers paid by farmers, this has varied across crops and countries and over time.

In India, two major crops account for a substantial part of total fertilizer consumption—paddy and wheat. The real price of nitrogen in terms of the number of kilograms of paddy required to buy a kilogram of
nitrogen varied from a low of 3.26 in 1973-74 (wheat, 2.74 in 1979-80) to a high of 5.88 in 1974-75 (wheat, 4.14) after the first oil shock. The latest price (1983-84) was 3.54 (wheat, 3.09). In the Republic of Korea, the real price in terms of bags of rice per ton of a mix of fertilizers varied from a low of 2.1 in 1973 and 1974 to a high of 4.3 in 1976, the current level being 3.4. In Egypt (Pitch et al., 1979), the real price of a kilogram of nitrogen in terms of ardebs (a weight measure) of wheat (maize) varied from .0160 (.0122) to .0247 (.0278) during the period 1970-1977. Couston (1978) presents the trends in crop-price ratios over time for the period 1970-1976 for a number of crops in eight Asian countries. Similar data are available for some Latin American countries in FAO/FIAC (1983a).

While there is a large body of experimental evidence on the response of different varieties of various crops to fertilizers under varying agro-climatic conditions, comparable data on the real-life response in farmers' fields of the same varieties and crops are scarce. In India, an average response of 9 kilograms of cereals per kilogram of NPK is often assumed; the marginal response is presumably lower. FAO/FIAC (1980) reports the following values for the ratio of the value of additional output of crops to the cost of fertilizers used, based on average responses from "best" treatments: Africa (South of Sahara), 6.0; Near East and North Africa, 3.2; Far East, 5.6; and Latin America, 4.9. However, these ratios varied substantially by crop. Moreover, they relate to averages resulting from the "best" treatment in experiments during the period 1961-1977. The relevant marginal values on farmers' fields are likely to be far lower. Further, as FAO/FIAC (1978) puts it, "Statisticians have warned how unstable estimates and inferences made from fertilizer response data may turn out to be. Estimation of fertilizer applications optimum for specific fertilizer cost-crop price ratios, for example, have extremely wide confidence limits" (p. 11). Yet it is impossible to evaluate the impact of subsidies on fertilizer consumption without some estimates of marginal crop response to fertilizer use.

The use of the crop-yield responses to fertilizers implicit in the estimates of the elasticity of fertilizer demand in assessing the impact of eliminating subsidies can be illustrated using Indian data. It is known that nearly 70 percent of the fertilizer used in India is applied to cereal crops, which account for 65 percent of the cropped area. Assume that the unitary price elasticity of total fertilizer demand estimated by Desai (1982) is applicable to the demand for application on cereal crops. Assume, further, that cereal producers maximize their profits per hectare by using fertilizers. Given these conditions, it can be shown that the implied response of cereal yield $Y$ per hectare is related to the use of nutrients $N$ per hectare as follows: $Y = a + b \log N$. Now assume that the ratio of the cost of a kilogram of nutrients (including the cost of application) to the price of a kilogram of cereals is on the order of 3.25 and the level of nutrient application on cereals is about 45 kilograms per hectare, as in 1982-83. The resulting estimate of $b$ is 146.25. If the fertilizer price subsidy to the farmer is on the order of about 20 percent, eliminating the subsidies while keeping cereal prices unchanged will raise fertilizer prices by 20 percent and reduce consumption by 20 percent--from
its 1982-83 value of 45 kilograms per hectare to 36 kilograms. This decline will reduce the yield per hectare by $146.25 \ (\log \frac{36}{45})$, or 35 kilograms per hectare. If about 100 million hectares were sown with cereal crops, the loss in cereal output would be about 3.5 million tons. If 70 percent of the US$550 million spent on fertilizer subsidies in 1982-83 went for the subsidies on cereal crops, it could be argued that the extra 3.5 million tons of cereals produced by the subsidies were worth US$385 million, or were bought at an implicit price of US$110 per ton. Since the import price of cereals was far higher, the government could argue that the subsidies were worthwhile.

Obviously this comparison of the returns from using US$385 million to subsidize fertilizer use on cereal crops or to import an amount equivalent to the output of cereals produced by the added use of fertilizers is limited. For example, it does not address whether using the same funds to expand irrigation or extension services would result in a larger volume of cereal production. More generally, this comparison does not establish the social optimality of a subsidy for fertilizer use. It only says that importing cereals is not a better alternative.
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Chapter 3

DESIGNING INCENTIVES FOR EFFICIENT PRODUCTION IN LARGE-SCALE ENTERPRISES: THE CASE OF FERTILIZER MANUFACTURERS

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I. INTRODUCTION

When a government decides to set prices or production levels rather than allowing the forces of supply and demand in the marketplace to do so, it is undertaking a difficult and complex task. This paper discusses some of the major factors governments should consider when setting prices and/or quantities for large-scale manufacturing enterprises, with particular reference to fertilizer producers. The focus is on the role that prices and other policy instruments can play in creating incentives for producers to operate if and only if they are economically viable, and to do so at minimum cost and optimal scale.

Section II addresses policy objectives and the role of subsidies. It notes that subsidies can dull incentives for efficient production. On the other hand, carefully designed regulatory schemes can help restore these incentives. Section II also explains why "standard" pricing rules are not valid when farmgate prices are established below the level of production costs.

Section III presents policy recommendations on how best to induce manufacturers to produce socially optimal levels of output. The focus is on specifying the conditions under which pricing rules are likely to outperform quantity targets, and vice-versa.

Section IV describes incentive schemes that can be employed to induce operations at minimum cost and to foster innovation and improvements in productivity. A number of general themes arise. One is that the compensation of managers must be tied directly to the performance of the firm. A second is that the performance of one firm should be measured against that of other firms and/or accepted industry norms.

Section V considers the situation in which a firm is expected to pursue non-economic objectives. In such cases, it is imperative that the objectives be explicitly defined and carefully valued.

Section VI offers some guidelines concerning when to end and when to continue the operation of individual plants. The discussion focuses on the relation between domestic production costs and the world price of fertilizers.

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Section VII offers a brief appraisal of current policies in India and Egypt, emphasizing those features that have the greatest relevance to other developing nations.

Section VIII concludes with a brief summary of the major policy recommendations.

II. SUBSIDIES, EFFICIENCY AND INFORMATION

Fertilizers are crucial to the economies of many developing nations. For a variety of reasons, it is often deemed essential that the final prices of fertilizers to farmers be kept low, for example, to promote the use of fertilizers, to subsidize agriculture and to maintain a desired relationship between fertilizer and crop prices. When farmgate prices are kept below the average costs of production, the government must provide subsidies to fertilizer producers if they are to continue operations.

There are inherent dangers in the use of subsidies. For one, the incentives to producers to minimize costs are dulled, since they are guaranteed the revenues to cover realized production costs. In addition, it becomes difficult to distinguish between firms that are economically viable and those whose costs exceed the value of their output.

To combat these undesirable consequences, regulation is needed. It can help restore the incentives for cost minimization and identify those firms that should close. The nature of the regulation is described in detail in Section III. However, briefly, two basic types can be employed: that which sets quantity targets and that which establishes ex-factory prices. Control of the rate of return on invested capital is an example of the latter. The former might involve setting a target level of production for each firm. If the firm achieved that target, it would receive a predetermined level of compensation. If production fell short of or exceeded the target, the compensation would be reduced or increased accordingly.

Whenever price regulation is contemplated, such standard rules as marginal cost-pricing immediately come to mind. Another standard is Ramsey pricing. Ramsey prices are those prices that will generate the largest amount of surplus to consumers and producers without bankrupting the firm. They differ from marginal cost prices when the production technology is characterized by increasing returns to scale. In this case, average costs exceed the marginal cost, so marginal cost prices will bankrupt the firm. For a more detailed discussion of Ramsey prices, see Baumol and Bradford (1970) or Kahn (1970).
level equal to the firm's marginal cost of production. Such a pricing scheme will induce the firm to produce the marginal unit of output if and only if marginal production costs do not exceed the value of that output to society, as measured by the willingness of farmers to pay for the product. The operation of marginal cost-pricing, then, depends crucially on the fact that ex-factory prices are not only the basis of revenue to the producer, but are also the prices that final consumers must pay for the product.

Thus, ex-factory prices can serve both to allocate output and to provide marginal compensation to the producer. When they do not serve both purposes, it is no longer the case that ex-factory prices should be set at the level of a firm's marginal production cost. Instead, ex-factory prices should be set to induce firms to produce the amount of output that consumers demand at the established farmgate prices. (Note, therefore, that when farmgate prices are set, careful attention should be given to the magnitude of the costs that will be incurred in meeting the realized demand for fertilizers.) Recall, though, that quantity regulations may induce a particular level of output and encourage cost minimization better than pricing regulations.

An important aspect of the fertilizer pricing problem that must be emphasized here is uncertainty. Many of the difficulties in determining optimal ex-factory prices (or production levels) stem from the fact that those who set the prices (or quantities) do not have perfect information about the firm's cost structure. If the costs were known perfectly, the socially optimal level of output and the minimum compensation required by the firm to produce this output would also be known. Hence, there would be no incentive problem. A major focus of this paper, then, is how best to induce a firm to achieve social objectives when the policy-maker is not perfectly informed about the firm's capabilities.

As to social objectives, here the focus is on the so-called "economic" ones: (1) ensuring production of the optimal amount of fertilizers, (2) fostering improvement in productivity and operations at minimum cost, and (3) ensuring operation by only those firms that are economically viable. These objectives are examined in detail in Sections III, IV and VI, respectively. Section V considers a variety of "non-economic" objectives, such as promoting domestic autonomy and providing jobs for workers. It is argued that many of the principles underlying the pursuit of economic goals are also crucial to achieving non-economic goals.

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2/ Note that transportation costs are not considered explicitly here or in the ensuing analysis. However, many of the policies that will be recommended to foster efficient production can also foster efficient distribution of fertilizers.

3/ This argument presumes that the distribution of income is socially optimal.
III. ENSURING SOCIALLY OPTIMAL PRODUCTION LEVELS

Ideally, producers should be induced to operate in the short run as long as the incremental costs of production do not outweigh the incremental gains that society derives from additional output. In the long run, capacity should be planned so that each plant operates at its optimal scale, i.e., where the average costs of production are the lowest.

These two rules for choosing the optimal levels of output are fairly straightforward and easy to implement when there is no uncertainty about the costs of producing or the benefits of consuming fertilizers. The same is not true, however, where there is uncertainty—as in the real world. Therefore it is essential to examine how best to induce production at socially optimal levels under conditions of uncertainty.

The starting point here is the case where uncertainty is initially symmetric. In other words, at the time policies are designed, it is assumed that the policy-maker and the firm share the same imperfect information about the environment in which the firm operates. However, after the policy is set and the firm begins operations, it may acquire better (perhaps perfect) information about its cost structure.

The first question is whether, when the policy-maker chooses between setting prices or quantities, one policy is clearly better than the other. The basic arguments are best illustrated with the aid of Figure 1. The lines depicting marginal benefits and costs are themselves quite thick.
to capture the idea that the precise levels of the benefits and costs at any level of output are unknown at the time the policy must be devised, although ultimately perfect information will be available.

The possible levels of marginal benefits and costs at any level of output lie within the lines. In Figure 1A, the benefit function is highly non-linear, while the cost function is relatively flat. The opposite situation is depicted in Figure 1B. Figure 1A presents a situation in which it is advisable to require that the firm produce a particular level of output (Q*) in return for a specified amount of compensation. If the situation in Figure 1B prevails, it is wiser to set a price (P*) and allow the firm to decide how much output to produce. The rationale for these conclusions is as follows. In Figure 1B, the fixed price, P*, establishes a reward structure for the firm that closely resembles the true marginal benefit curve. Thus, after the uncertainty is resolved and the firm learns its cost structure, it will find that its own private interest involves a level of output close to the socially optimal level.

On the other hand, if a price is established under the setting of Figure 1A, the ensuing compensation scheme facing the firm will generally not approximate closely the social benefit function. The firm, acting in its own self-interest, is likely to produce a level of output very different from that which is socially optimal. Therefore, under the conditions in Figure 1A, it is advisable to choose a particular quantity target and to reward the firm with a fixed payment for achieving that target. 4/

An example of the situation in Figure 1A is an economy that is entirely centrally planned, in which the production technology is constant returns to scale. The total benefit function is relatively kinked in a planned economy, particularly where the product is an input in other industries. It is crucial that a precise amount of such a product be manufactured. Too little output will cause shortfalls in production at all successive stages, and too much output has no use. In such an economy, quantity targets may be more successful than pricing rules in inducing production of the socially optimal amount of output. On the other hand, if there are capacity constraints in production and the social value of each additional unit of output is approximately the same, the situation in Figure 1B prevails, and pricing rules are recommended over quantity targets.

A common pricing rule is rate of return regulation. The main idea behind rate of return regulation is to eliminate the flow of excess profits to a firm by restricting the price at which its product can be sold. At the same time, ex-factory prices, which are the firm's sole source of revenue, are set so as to allow the firm a fair return on invested capital. Ideally, the fair return should be just sufficient to attract new capital as the old depreciates. What constitutes a fair return will, of course, depend on the risk involved in operations. Inasmuch as

4/ This discussion is based on the insightful work of Weitzman (1974).
the allowed ex-factory price is tied to the firm's capital stock and not its variable operating expenses, rate of return regulation provides the correct incentives for the firm to minimize variable production costs. Thus, the scheme is generally preferable to a simple cost plus scheme, wherein the firm is compensated for all costs and then given an additional (fixed) bonus.\footnote{Two drawbacks to rate of return regulation are well-documented in the economics literature (see, for example, Averch and Johnson, 1962; Baumol and Klevorick, 1970; and Bawa and Sibley, 1980). First, rate of return regulation induces a firm to "overcapitalize," \textit{i.e.}, to use too much capital relative to other inputs. This effect arises because the amount of capital employed determines how high the firm's ex-factory price will be set. Second, this system may dampen the incentive a firm has to innovate, as the returns from wise investments do not flow completely to those who design the investments. "Regulatory lag" (the practice of revising prices downward to reflect productivity improvements only after a significant period of time has elapsed) can alleviate this second difficulty.}

Of course, the policy-maker does not face a dichotomous quantity or price choice. Combinations of the two may be employed. For example, a government might establish a quantity target (and an associated level of compensation), and then institute a bonus for exceeding the target and a penalty for falling short. Optimally, these penalties and bonuses should reflect the net social benefits and/or costs of deviating from the target. However, if managers in firms are risk-averse, it is not advisable to force them to bear the entire consequence of circumstances that are truly beyond their control (\textit{e.g.}, severe weather). Thus, penalties for underachievement should be below the net social costs incurred if it can be demonstrated that the shortfall was unavoidable.\footnote{It is also important that managers not be led to claim that all failures are beyond their control. One way is to force them to bear all costs incurred in evaluating a claim that turns out to be false.} The important general principle here is that managers should be held liable for avoidable failures and be rewarded for successes they create.\footnote{For some general theoretical discussion about the design of incentive structures when risk-sharing and moral hazard are important considerations, see Harris and Raviv (1979), Holmstrom (1979), Sappington (1983a) and Shavell (1979).}

The foregoing recommendations assume that the policy-maker and firm originally faced the same uncertainty concerning the cost (and benefit) functions. Quite often, however, the firm's information about its cost structure is better than the government's at the start. Under such circumstances, industrial policy should be to make use of the firm's privileged information to the extent it can.

To illustrate this point, consider a case in which the beliefs of the government and firm are those depicted in Figure 2. They have a common belief as to the social marginal benefit function. However, the firm is
better informed about the marginal costs of production. It knows which of the three lines (H, M or L) corresponds to actual costs, while the government does not. If the government were to proceed solely on the basis of its own beliefs, it might set a target $Q^m$, thinking that the marginal costs are most likely represented by line M. If line L represents actual costs, however, the level of output $Q^m$ is not the level $(Q^1)$ at which the difference between total benefits and costs is greatest. Clearly, the government could generally choose a better target if it shared the firm's privileged information.

The firm, on the other hand, might not find it in its interest to reveal the truth. It might find it more advantageous, for example, to claim that its costs were higher than was actually the case (e.g., that its marginal costs were given by line H rather than by Line L).

When an asymmetry of information such as that depicted in Figure 2 prevails, social gains can be realized if the firm is permitted to make a binding choice from a carefully designed menu of target/payment pairs. The basic characteristics of this menu are as follows. Starting from a proposed target (such as $Q^m$) and associated payment level, the firm should be allowed to choose a higher or lower target. Achieving the higher target, such as $Q^1$, will yield a larger payment. However, output in excess of the new target will not result in a large reward, whereas failure to meet the target will result in a relatively severe penalty. If, on the other hand, the firm chooses a lower target such as $Q^h$, its payment for meeting the target will be smaller. Similarly, its compensation for
exceeding the lower target will be small, while the penalties for falling short will be particularly severe. (The formal details of this plan are described in the Appendix.) Here the important point is that when firms possess private information that is socially valuable, they have to be given incentives to reveal it. Although the incentives generally involve the award of some rents, paying for the information is generally preferable to not buying it at all.

Two other points relative to setting targets and bonuses are important. First, it is in the social interest that targets be achieved at the minimum possible cost. Otherwise, vital resources will be wasted. To ensure that costs are minimized, managers must be held accountable for the inputs they employ in meeting their targets. In cases where inputs are allocated to firms rather than being purchased by managers, the compensation of managers should be reduced if consumption exceeds accepted industry norms, with the penalties reflecting the true social costs of the additional inputs. To implement such a system properly, it is necessary to adopt a uniform accounting system, wherein inputs are valued at their social opportunity cost.

The second point is that the interaction between managers of firms and policy-makers is ongoing. The managers may have an incentive to produce too little output today if current performance is used to determine tomorrow's target. Such a possibility can be partially averted if the future targets for a firm are based not on the firm's current performance, but on the current performance of comparable firms or according to accepted world standards. (Comparable firms are those with similar technologies operating in similar environments.) The idea of basing compensation for one firm on its performance relative to other comparable ones or world standards is important (this point surfaces again in Section IV).

IV. CREATING INCENTIVES TO MINIMIZE COSTS AND IMPROVE PRODUCTIVITY

Whatever the production level of a firm, it is desirable that its output be produced at minimum costs. One policy to induce cost minimization, discussed briefly in Section III, is to create a uniform accounting system according to which managers are charged for the inputs they use in excess of accepted norms. On the other hand, if their consumption of inputs falls below the norm, they receive a bonus proportional to the social value of the resources saved. The key idea is to link the compensation of managers directly with performance, in order to provide the managers with incentives to minimize production costs. As such, input prices must be accurately assessed.

8/ This discussion and the details in the Appendix are based on Weitzman (1976).

9/ This general theme is analyzed in greater detail in Baron and Myerson (1982) and Sappington (1982 and 1983b).

10/ This possibility is explored in some detail by Loeb and Magat (1978).
Proper incentives can also be created to minimize costs without that linkage. Simple policies such as public recognition, promotion and praise may suffice. The power of these rewards is, however, difficult to assess, and they are likely to be more effective if used in conjunction with monetary rewards.

An accurate accounting system may take time to establish. A possible interim measure is to reward managers for achieving average costs below those of comparable firms and/or world cost standards. \(^{11/}\)

Other policies also encourage cost minimization. One is to create "yardstick" enterprises to establish standards against which the performance of other firms (whose compensation is regulated by the government) can be compared. While yardstick enterprises may have slightly higher costs than other firms, the information they provide may enable the government to enact more informed policy measures, an outcome that justifies their operation. Any enterprise to be used as a benchmark should have specifications similar to those plants whose performance is to be compared. \(^{12/}\)

A yardstick enterprise may also be used to disseminate technical information the government possesses. By incorporating state-of-the-art technology in a public enterprise and inviting managers of other firms to acquaint themselves with the plant, the average performance of all firms in a region can be improved. \(^{13/}\)

Important technical information can be rapidly disseminated in other ways. First, the development of trade associations can be encouraged: their meetings are particularly good forums for an exchange of ideas about new techniques. Second, more direct and formal lines of communication can be established among plant managers. For example, "twinning" is a technique by which the expertise of an established enterprise can be transferred to a new one. The new enterprise receives technical assistance (and often on-site training) from its designated twin, with the close interaction with experienced staff proving invaluable to inexperienced staff. \(^{14/}\)

\(^{11/}\) Some theoretical discussions on how best to design incentive schemes simultaneously for a number of firms can be found in Demski and Sappington (1984) and Nalebuff and Stiglitz (1983).

\(^{12/}\) Note that yardstick enterprises need not be public, or even run by domestic managers. This idea is developed in greater detail below.

\(^{13/}\) Mieko Nishimizu of the World Bank suggested this possibility; the Japanese have often used the yardstick enterprise in this capacity.

\(^{14/}\) Shirley (1983) describes a successful "twinning" of the Tanzanian Electric Supply Company Limited and the Electricity Supply Board of Ireland in 1977.
It is important to provide proper incentives to experienced staff to devote their time and effort. One approach is to devise a formal incentive scheme whereby the experienced twin receives a bonus payment that increases as the performance of the inexperienced twin improves.

A third approach to information dissemination is to expose domestic firms to international competition. While there may be good reasons to shield infant industries from that competition, it can provide established firms with an important stimulus, while serving as a good source of information about new production techniques. 15/ At the same time, local governments can use the comparison between domestic and foreign producers inherent in competition to discipline firms over which they have control. 16/

Information dissemination and inter-firm comparison can serve not only to hold current costs to a minimum, but also to foster innovation and thereby lower future costs. Innovation requires research and development (R&D). Key features of much R&D are that: (1) it is risky, in the sense

15/ This point was raised by Shirley (1983).
16/ Managerial expertise is an important and scarce resource whose value should not be overlooked. Therefore, the system by which managers are trained, promoted and retained is another key factor in ensuring that production costs are minimized. Because the proper training of managers is costly, its costs and benefits should be carefully weighed against the alternative of hiring foreign managers to run domestic plants. Of course, one drawback to this alternative is a possible loss of domestic autonomy. The magnitude of the sacrifice should be carefully valued before any decision is made.

Training managers is an investment in human capital. Because human capital is mobile, it is hard to protect the investment once made. Therefore, extreme care should be taken to retain good managers. There are a variety of ways to do so. Tenure and promotion should be used to reward managers with desirable performance records. Since managerial expertise takes time to acquire and may be specific to a particular plant, an objective should be to retain the services of good managers for long periods of time. Further, if the tenure of a manager is short, he or she may be unwilling to undertake socially desirable investments whose payoffs are not likely to be realized until after the expiration of his or her tenure.

Once the possibility of tenure is extended to successful managers, it is crucial that they find it attractive to remain with the firm. Thus, a manager's pay should rise steeply with tenure and be competitive with salaries in the private sector. It might also be wise to institute a policy whereby private firms that hire former managers of public enterprises be required to pay a special tax. This tax would be designed to capture a fraction of the cost of training the manager.
that the return from investments is uncertain; and (2) the products of successful R&D ventures are often public goods, i.e., the use of the products by one firm need not diminish the possibilities of their use by others. On both counts, joint R&D ventures should be encouraged. Under this approach, the risks of the project are shared, as are the costs, and the benefits can be enjoyed by all. In fact, mandatory contributions by non-participating firms to finance the R&D may be advisable when it is difficult to exclude them from reaping its benefits.17/

Although managers of firms may have better information than the government about the value of a particular innovation to their operations, they must still be provided with the incentive to decide whether to adopt it. This incentive is best created by awarding managers a share of the net cost savings realized as a consequence of their decision. In evaluating net cost savings, it is essential that the resources employed in the plant be valued at their true social opportunity cost.

V. ACHIEVING AND DEFINING NON-ECONOMIC GOALS

To this point, the discussion has focused on what might be termed economic objectives, that is, producing the socially optimal amount of output, minimizing the costs of production and promoting improvements in productivity. Often, however, public enterprises are created with non-economic objectives in mind, such as creating employment, developing the infrastructure or providing implicit subsidies to certain sectors of the economy. These objectives are by no means less important than the economic ones. However, they are often left unstated, and the costs and benefits associated with attaining them are rarely calculated.

For a variety of reasons, it is a mistake to leave these types of policy objectives unstated. If the objectives of an enterprise are not clearly defined, it is impossible to judge the performance of managers. Consequently, it is difficult (if not impossible) to induce the managers to achieve the social objectives. Another problem is that where objectives are not stated explicitly, it is unlikely that the costs and benefits of achieving them will be considered carefully. As a consequence, policies may be carried out whose costs exceed their benefits. Further, the least cost alternative may not necessarily be used to pursue the social objectives. For example, Shirley (1983) cites a study in Egypt which concluded that the goal of full employment could have been achieved at lower cost if public enterprises had not been required to hire excess labor. Instead, the profits of the more efficient enterprises (without the excess labor) should have been employed to create new jobs elsewhere in the economy.

17/ The difficulty of excluding non-participants from the benefits of a project is known as the "free rider" problem in the economics literature (see, for example, Groves and Ledyard, 1977, and Groves and Loeb, 1975). Complicated tax schemes do exist that induce individuals (firms) to reveal correctly their private valuations of public goods, such as the outcome of successful R&D projects.
Once the policy objectives are stated clearly, an incentive scheme must be designed to induce managers to achieve them. This will require decisions about their relative values. Once these relative values are determined, they must be reflected in the incentive scheme put before the manager. Only then can the manager be expected to try to implement the objectives at least cost.

It is not easy to assign each objective a precise monetary value. It is even more difficult to determine the magnitude of the social costs incurred for every deviation from the objectives. Hence, some compromise must be reached between how detailed and comprehensive the managerial incentive scheme will be, and how closely the social objectives will be pursued.

The optimal compromise will be determined by the factors discussed in Section III. For example, when the expected benefit function is sharply kinked and the average expected costs of producing a particular social good (e.g., employment) do not vary much with the level of production, specifying a quantity target and associated bonus may be preferable to allowing a fixed price to determine the manager's compensation.

VI. ENSURING THAT ONLY ECONOMICALLY VIABLE PLANTS OPERATE

The preceding discussion focused on how best to induce firms to achieve certain economic and non-economic objectives. A question not yet addressed is whether a firm should be allowed to continue operations.

Fertilizer producers in many developing countries are subsidized in the sense that the firms continue to operate even when their costs exceed the revenues derived from final sales. As noted earlier, these subsidies are deemed necessary to promote the use of fertilizers and to keep input prices to farmers low.

One of the primary dangers of subsidies is that they can blur the distinction between firms that are economically viable and those that are not. This danger is particularly apparent in an environment where firms do not have to face the ultimate test of attracting consumers to buy their products with prices that simultaneously determine the firm's revenue. Thus, when a government decides to implement subsidies, it must also devise a policy to determine how large the subsidies can become before a firm should be closed.

The paramount principle here is that a firm should continue to operate as long as the (present discounted value, or PDV, of the) stream of expected benefits derived from its operation exceeds the (PDV of the) stream of expected costs. However, the streams of anticipated benefits and costs are difficult to estimate. As noted earlier, it is often difficult even to specify what the benefits (and objectives) of a particular public or regulated enterprise are. Consequently, it is essential to develop a policy that can make this principle operational.
Rate of return regulation can serve as the cornerstone of such a policy. A maximum ex-factory price that will be allowed should be appended to the standard rate of return regulation described in Section III. An obvious standard is the world price of fertilizer. However, there are at least two reasons why it would be unwise to close a plant whenever the world price of fertilizer fell below the price that guarantees a domestic firm a fair rate of return. First, the social value of domestic production may exceed the value of the quantity of fertilizer produced. For example, domestic production can reduce long-run dependence on foreign supplies, thereby avoiding the costs associated with an interruption in imports. Even short interruptions can be quite costly, as there is a very short time span each year within which the application of fertilizers is economical. Thus, domestic production may be socially desirable even though production costs exceed the spot price of fertilizer. Domestic production may also conserve scarce foreign exchange reserves.

Second, there are costs associated with initiating and terminating operations at a plant. Start-up costs include retraining former employees and training new ones. Shutdown costs include severance payments to workers and the costs of maintaining a dormant plant. If these costs are large, operating domestic plants if and only if the world price exceeds the price that promises a fair rate of return is generally not advisable.

It should not be inferred that the world price of fertilizer should not serve as a signal of economic viability. The world spot price of fertilizer does reflect the short-run marginal cost of obtaining fertilizers. Decisions about whether to terminate the operations of a particular plant are, however, long-run ones and should be based on the long-run world price of fertilizer.

Predicting a long-run world price of any commodity accurately requires sophisticated econometric forecasting techniques. Predicting prices of fertilizers is particularly difficult because of a number of special features in the industry. First, production costs are very sensitive to the price of energy (natural gas, oil, etc.), and any volatility in energy prices translates directly into volatility in fertilizer prices. Second, there is collusion among the major producers of fertilizers: prices are not determined solely by the unrestrained forces of supply and demand, but are subject to manipulation by major producers. Third, fertilizers can be stored, and a fairly large percentage of the fertilizers purchased on the world market is concentrated in the hands of a few large buyers. These last two factors make total market demand sensitive to expectations about future prices. When prices are expected to rise sharply, buyers will stockpile fertilizers. Indeed, panic buying has been observed in the fertilizer market in recent history. A fourth point is that because many fertilizer producing units are characterized by high fixed costs and comparatively low marginal costs, they may find it profitable to cut prices sharply in order to attract customers at times when demand is low. 18/

18/ For more details on this concept of "destructive competition," see Scherer (1980).
These four factors are also reasons why the maximum allowed ex-factory price for domestic fertilizers should not be tied directly to the world spot price of fertilizer. The value in such a link stems from the ability of the world price to reflect long-run changes in demand or supply conditions accurately. To the extent that fluctuations in the world spot price reflect transitory disturbances in the market, domestic producers should be shielded. Otherwise, investment in fertilizer manufacturing plants will be unduly risky and will be discouraged.

Theoretically, then, the maximum allowed ex-factory price of fertilizer should be linked to the projected long-run world price. In practice, however, all projections are subject to error. Hence, a reasonable compromise might be to link the maximum price to a weighted average of the projected price and the spot price. The greater the confidence in the projections, the greater the weight that should be placed on the projected long-run price. Projections should be revised regularly, perhaps every six months.

Using the projected long-run world price to determine whether plants should be closed produces two simultaneous benefits. First, it reduces the risk individual producers face. Second, governments have a concise, credible means of communicating valuable information to local producers about future trends in the industry. As it is less costly for a central agency to perform the projections, it would be wise for the governments using the projections to fund the research jointly.

Price projections can be used in conjunction with incentive schemes other than rate of return regulation. The key principle is that plants should be shut down if the expected long-run compensation paid to the firm exceeds the expected costs that would be incurred if the fertilizer were purchased at the projected world price. Again, this principle must be modified if benefits and costs beyond strictly monetary ones are important in decisions about plant closures. If, for example, a developing country values autonomy highly, it may allow a plant to operate even though its product could be obtained more cheaply on the world market. Moreover, the value of increasing foreign exchange reserves via domestic production must be assessed carefully.

Finally, there is an alternative to simply shutting down plants judged to be not economically viable—an auction. A plant may not be viable not because of its physical facilities, but because of poor management. In such a case, the right to operate the plant can be auctioned off to the highest bidder. The new owner, in turn, would be allowed an ex-factory price that does not exceed the projected long-run world price of fertilizer. Although there are a variety of potentially serious problems with auctions, in some situations they can be employed successfully to enhance social welfare. 19/

19/ For a discussion of the merits of "franchise bidding," see Demsetz (1968). For some important thoughts on the drawbacks of the plan, see Williamson (1976).
VII. INCENTIVE SCHEMES IN INDIA AND EGYPT

To this point, the focus has been on the general principles that underlie the optimal design of incentive schemes to foster independent, cost-minimizing operations at appropriate levels of output. This section considers briefly the implications of these principles for two specific incentive schemes—those of India and Egypt. The Indian plan is centered on a pricing rule, while the Egyptian plan relies heavily on quantity targets.

The pricing rule adopted in India is rate of return regulation as described earlier. Ex-factory prices are calculated to yield a fair rate of return (12 percent post-tax on net worth) if the plant operates at 80 percent of capacity and meets certain consumption norms. The price allowed to each plant depends on its vintage and therefore its capabilities; older plants generally have higher costs and greater maintenance requirements. The capability of each plant is determined by technical investigation, taking into account industry norms. Ex-factory prices are updated periodically, but more often as input prices change more rapidly.

India's incentive scheme is basically sound. Rate of return regulation is a proven means of inducing firms to operate without awarding them excessive profits. However, the system does require a good deal of technical information to make different allowances for different plants; however, production techniques tend to be fairly standard, so the relevant information may not be too costly to compile.

A few features of the Indian plan do require further thought. Are adequate incentives provided to attract and retain highly qualified managers? Here some of the suggestions in footnote 16 might warrant consideration. Are adequate incentives provided for R&D? One common objection to rate of return regulation is that if prices are revised downward after cost reductions are effected so as to maintain the fair rate of return, the firm has little or no incentive to innovate. An alternative is to compare a plant's performance with industry norms or world averages. Another alternative is to allow those firms that effect greater cost reductions to earn a higher rate of return than others. (Recall also the comments in footnote 5.)

It is also not apparent that adequate incentives are provided to produce the socially optimal levels of output when the fair rate of return is based on a capacity utilization rate of 80 percent. Because fertilizer manufacturing plants exhibit economies of scale (i.e., the average costs of production fall with output up to capacity), the Indian plan will provide some incentives for firms to achieve high rates of capacity utilization. The question is whether the incentives are sufficiently strong.

Recall the discussion in Section III. Pricing rules work well to induce socially optimal levels of output if the expected social benefits do not vary greatly with output, but average production costs vary

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20/ The Indian plan also contains commendable features to induce timely, efficient distribution of fertilizers. As the focus in this paper is on production, these features are not discussed.
substantially with output. Thus, with attention to Figure 3, if production costs are as depicted in Figure 3A, so that large economies of scale exist beyond 80 percent of capacity, the incentive to achieve higher levels of output will be strong. If only small-scale economies persist beyond 80 percent of capacity, as shown in Figure 3B, the incentive to achieve higher rates of output is weak. Hence, an informed judgment as to how successful the rate of return incentive scheme can be at inducing production of socially optimal quantities of output requires careful empirical investigation of both the cost structures of firms and the nature of the social value of fertilizers.

In Egypt, the incentive scheme is based on quantity targets rather than prices. The government and individual firms agree on a target for the firm, with a bonus paid if the target is achieved.

Many of the comments in Section III are directly applicable to the Egyptian plan. First, it is generally advisable to allow the firm to make a binding choice among target/bonus pairs. By doing so, the firm can be induced to employ its private information for the social good. Second, future targets for each firm should be based on the current performance of the average costs of comparable firms or on world standards. This approach precludes the tendency of firms to sacrifice current performance to obtain easy targets in the future.

Third, the penalties and bonuses that firms face should reflect the net social costs and benefits of failing to meet or exceeding the target. Ad hoc bonuses that firms consistently count on receiving will not induce socially optimal levels of output.

Fourth, firms must be held accountable for the inputs they employ in order to meet their targets, and net proceeds to a firm should vary inversely with its costs. Again, when evaluating costs, inputs should be valued at their social opportunity cost.

Two other points warrant brief mention. First, it is important to determine whether the target/bonus system provides sufficient incentives for R&D. Firms must be compensated for cost reductions that are effected; otherwise, they will have no incentive to improve productivity. Second, it is important to implement a plan (such as that suggested in Section VI) whereby plants that are no longer economically viable are shut down. Plants should be closed when the total value of the resources that flow to them outweighs the social opportunity cost of obtaining their product elsewhere. Thus, if the average operating expenses of a plant (including bonuses and with inputs valued at their social opportunity cost) consistently outweigh the projected world price of fertilizers, the plant should be closed. A prerequisite, once again, for implementing such a scheme is a reliable internal accounting system.

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21/ The shadow prices used to calculate costs need not coincide exactly with prevailing monetary prices. In Turkey, for example, the shadow prices of domestic inputs are set lower than their monetary equivalent in order to promote development of the domestic industry.
VIII. POLICY RECOMMENDATIONS

The purpose of this paper is to outline the manner in which three major objectives of industrial policy can best be achieved. They are: ensuring cost minimization and improvements in productivity; inducing production of socially optimal levels of output; and ensuring that only economically viable firms operate in the long run. In general, it will be difficult to achieve all these goals simultaneously. Further, the best way to attain them will vary from country to country, depending on the economic environment. Nevertheless, a number of broad policy recommendations emerge.

Most important, the objectives a firm is expected to achieve must be stated clearly, as must the value to society of achieving them. Without a formal statement of what a firm is expected to do and how valuable its achievements are, the objectives, whether economic or non-economic, cannot be achieved, and the firm's performance cannot be evaluated.

Once the objectives are clearly stated, the compensation of the managers that run the firm must be linked closely to performance. The key principle is that managers must be made to bear responsibility for their actions. They must be penalized in proportion to the social costs incurred.
from such things as cost overruns or from failing to meet the targeted level of output. On the other hand, they should receive bonuses proportional to the incremental social benefits that flow from their actions. Thus firms may end up earning more or less than the fair rate of return, depending on their performance. It is not recommended, however, that managers be forced to bear the risk of outcomes beyond their control.

Governments can employ two basic policy tools to induce a firm to produce the socially optimal levels of output—prices and quantities. Establishing an ex-factory price as the firm's source of compensation is advisable when the social marginal benefits from increased output, unlike average production costs, do not vary much with the level of output. If, however, expected social marginal benefits are sharply peaked at some level of output, while average production costs are roughly constant, setting a quantity target can be superior. Quantity targets, then, are likely to be most effective in a centrally planned economy where, for purposes of coordination, it is crucial that a particular amount of output be produced.

The managers of firms will often have private information (for example, about the firm’s cost structure) that would be of value to the government in determining appropriate output targets for each firm. Managers, however, cannot be expected to reveal this private information unless it is in their interest. Two strategies have been proposed. First, firms should be permitted to make a binding choice from among a variety of target/bonus schemes. Second, future targets for any particular firm should be based on the current performance of other comparable firms or on world standards, rather than on the firm's current performance.

This latter strategy of comparative performance is one that governments should employ to achieve a variety of goals. For example, if firms whose costs are below the average for comparable firms are given financial bonuses, the incentives for cost minimization will be enhanced. However, inter-firm competition is not always advisable. The best way to foster R&D, for example, may be to encourage joint ventures. They allow valuable information and experience to be shared and can avoid duplication of costs.

Finally, it was recommended that the long-term projected world price of fertilizers be used as a benchmark to determine whether firms should continue operations. If the value of the resources that a firm employs to produce a unit of output (where inputs are appraised at their social opportunity cost) exceeds the projected price at which the firm's output can be purchased on the world market, then the firm is not financially viable. Its continued operation can only be justified if it provides other social benefits. For example, domestic products may be preferred to imports because they increase the country's autonomy and conserve foreign exchange. To the extent that extra benefits exist, they should be carefully valued to determine whether the total benefits from the firm's operations exceed the associated total costs to society.
APPENDIX

A PLAN WHEREBY A FIRM CAN CHOOSE A TARGET/BONUS PAIR

Initial Negotiation Stage

\[ q_0 = \text{Original target level of output for the firm} \]
\[ B_0 = \text{Original bonus the firm receives if the target is achieved} \]

Subsequent Choice by Firm

\[ q_n = \text{New target level of output chosen by the firm} \]
\[ B_n = b[q_n - q_0] = \text{New bonus the firm receives if the new output level, } q_n, \text{ is attained exactly} \]

Final Payoff Stage

\[ q = \text{Actual output produced by firm} \]
\[ B = \text{Actual bonus payment to firm, where} \]
\[ B = B_n + a^s [q - q_n] \text{ for } q \geq q_n \]
\[ B = B_n - a^f [q_n - q] \text{ for } q_n > q, \]

and where
\[ 0 < a^s < b < a^f. \]

The Major Implication of the Plan

A firm will choose a higher target if and only if it believes that it can meet that higher target.
REFERENCES


PART II

FERTILIZER PRICING IN PRACTICE:
THE EXPERIENCE OF 10 COUNTRIES
Chapter 4

FERTILIZER PRICING IN EGYPT

Ragaa El-Hady Ennara
First Under Secretary of State,
Ministry of Industry and Mineral Wealth

I. THE FERTILIZER INDUSTRY

Production

Early in this century, usage of chemical fertilizers in Egyptian agriculture was confined to imported natural sodium nitrate. However, Egypt has abundant phosphate rock, a raw material for producing phosphatic fertilizers. Given this resource, a domestic fertilizer plant for single super phosphate was erected in 1936 at Kafr El-Zayat, a town in the middle of the Nile Delta. Another single super phosphate factory was built near Cairo in 1936, a third in 1969 at Asyout, a city between Cairo and Luxor. The production of single super phosphate is now about 600,000 tons a year, calculated as 15% P_2O_5. As this amount does not meet the demand, which is about 1.1 million tons, the balance is imported as triple super phosphate. A triple super phosphate plant is under construction at Abu Zabaal near Cairo. It will have a capacity of 1.2 million tons (calculated as 15% P_2O_5) and is due to come on-stream in 1984/85. It will meet the requirements for phosphatic fertilizers until 1987.

As to nitrogen fertilizers, the first nitrogenous fertilizer plant, located in Suez, started producing calcium nitrate early in 1951. Other plants erected subsequently produce ammonium nitrate, ammonium sulphate and urea. The raw material used for nitrogenous fertilizers is natural and associated gas. Although one plant near the Aswan High Dam is based on electrolysis of water, studies are being carried out on converting it to gas. Total production is now about 4.4 million tons a year (calculated as 15.5% N).

The Government plans to expand existing plants and to implement new projects to meet the growing requirements for nitrogenous and phosphatic fertilizers. Initially, the fertilizer industry was private. However, in 1961 it was nationalized and is now totally state-owned.

Marketing and Distribution

Trade in fertilizers was also nationalized in 1961. The Ministry of Agriculture imports the fertilizers, while an agency—the Bank of Agriculture and Cooperative Credit (BAACC)—under the Ministry is the sole wholesaler. Typically, the fertilizer producers provide their production plans in advance each year to the Ministry of Agriculture so that it can plan for imports. The BAACC sells both imported and local fertilizers to
farmers through its depots all over the country. The Ministry of Agriculture specifies the kind of fertilizer to be used for each crop and the quota per area cultivated.

II. PRICING POLICY

When the fertilizer industry was nationalized in 1961, single prices were set for both locally produced and imported fertilizers. At that time, prices were based on production costs plus a reasonable profit. Subsequently, costs rose rapidly, whereas prices could not be increased concomitantly for social reasons.

The objectives of the present pricing policy are, in summary, to:

- Unify the selling prices to farmers for locally produced and imported fertilizers.
- Maintain a reasonable relationship between the prices of fertilizers and crops.

The fertilizers produced in different plants and the imported fertilizers have different costs. Since the policy is to offer the fertilizers to farmers at a fixed price, the Government sets ex-factory prices for all producers and prices for the BACC stores. An organization for the stabilization of fertilizer prices, the General Organisation for Agricultural Prices Equalisation (GOAE), calculates the cost of fertilizers ex-factory and at the BACC store, jointly with the Ministry of Industry. If the buying price is less than the cost, the GOAE refunds the difference to the producers.

The Government fixes a single price for farmers for both imported and domestically produced fertilizers. The BACC sells the fertilizers to farmers at a higher price than its buying price. The profits go to finance the GOAE. On the other hand, the price of imported fertilizers is less than the cost of importation. The GOAE bears the difference, using the profits from the sale of local fertilizers and funds allocated from the Ministry of Finance.

The following examples illustrate the system:

- Single super phosphate

<table>
<thead>
<tr>
<th>Description</th>
<th>US$/ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of production</td>
<td>87</td>
</tr>
<tr>
<td>Freight cost to BACC stores</td>
<td>4</td>
</tr>
<tr>
<td>Total cost</td>
<td>91</td>
</tr>
<tr>
<td>Fixed buying price ex-factory</td>
<td>21</td>
</tr>
<tr>
<td>Fixed buying price at BACC stores</td>
<td>22</td>
</tr>
<tr>
<td>Total producer loss</td>
<td>69</td>
</tr>
</tbody>
</table>
The GOAE provides the producer US$22 for each ton delivered to the BACC stores. On the other hand, the BACC stores sell this fertilizer to the farmer at US$30.3 a ton, yielding a profit of US$8.3 a ton to GOAE. At the same time, the BACC also sells nutrients imported by the Ministry of Agriculture, such as triple super phosphate (TSP). The average cost of imported TSP at BACC stores is about US$150 a ton, whereas the selling price to farmers is about US$86 a ton. The GOAE absorbs the difference.

Calcium ammonium nitrate, 31% N

<table>
<thead>
<tr>
<th>Description</th>
<th>US$/ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of production</td>
<td>69</td>
</tr>
<tr>
<td>Freight cost to BACC stores</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total cost</strong></td>
<td><strong>73</strong></td>
</tr>
<tr>
<td>Fixed buying price ex-factory</td>
<td>38</td>
</tr>
<tr>
<td>Fixed buying price at BACC store</td>
<td>41</td>
</tr>
<tr>
<td><strong>Total producer loss</strong></td>
<td><strong>32</strong></td>
</tr>
</tbody>
</table>

The producer receives US$41 for each ton delivered to the BACC. The BACC then sells to farmers at US$84.5 a ton, giving the GOAE a profit of US$43.5 a ton.

This system applies to all nitrogenous fertilizers except urea. Only recently being produced in Egypt, the ex-factory price of urea works out to US$122 a ton, which is presently adequate to ensure a reasonable rate of return on investment. Urea is delivered to the BACC stores at US$130 a ton, while the BACC sells it to the farmers at US$126 a ton, with the GOAE bearing the loss.

Under this pricing system, producers are reimbursed for the cost but receive no profit. The subsidy actually goes to the farmers. The total amount of the subsidy varies according to the quantity of fertilizers produced locally and imported.

Fertilizer and Crop Prices

Control of fertilizer prices has helped control crop prices. The Government does fix the price of main crops, using a positive cost plus system with a profit margin for farmers; it applies mainly to cotton, sugarcane, rice, wheat, etc.

III. EFFECTIVENESS OF THE SYSTEM

The pricing system has helped to meet the policy objective of controlling agricultural prices. However, there have been some drawbacks:
The producing companies do not get the margin of profit necessary for further investment.

- There is usually a delay in revising the production costs, which leads to delays in reimbursing the producers, causing a lack of liquidity and other financial problems.

- Producers are not induced to minimize production costs or to increase productivity.

- The fixed prices do not relate to international prices, as shown below:

<table>
<thead>
<tr>
<th>Fertilizer</th>
<th>Factory ex-gate price US$/ton</th>
<th>Average int'l price (c.i.f.) US$/ton</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSP</td>
<td>21</td>
<td>- c/</td>
<td>Not imported</td>
</tr>
<tr>
<td>TSP</td>
<td>- b/</td>
<td>150</td>
<td>Imported</td>
</tr>
<tr>
<td>CN 15.5% N</td>
<td>21</td>
<td>90</td>
<td>Not imported</td>
</tr>
<tr>
<td>CAN 31% N</td>
<td>38</td>
<td>130</td>
<td>Not imported</td>
</tr>
<tr>
<td>AS 20.6% N</td>
<td>33</td>
<td>100</td>
<td>Not imported</td>
</tr>
<tr>
<td>Urea 46.5% N</td>
<td>122</td>
<td>160</td>
<td>Not imported</td>
</tr>
</tbody>
</table>

a/ In early 1984.
b/ No domestic production.
c/ Not significantly traded.

Source: Ministry of Industry and Mineral Wealth.

- In general, producers would prefer to have a cost plus price system. It would eliminate the complicated financial relations with the BACC and GOAE.

Clearly, while the pricing policy has achieved its main goals, especially that of price control, it has disadvantages for producers. Given the plans for rehabilitating and expanding old factories and the construction of new projects, the industry should be able to achieve self-sufficiency. At that point, the pricing system will most probably be changed to rectify the disadvantages.
Chapter 5

FERTILIZER PRICING IN NIGERIA

O. E. U. Etuk, Director,
Fertilizer Procurement and Distribution Division,
Federal Ministry of Agriculture and Water Resources

I. INTRODUCTION

The importance of fertilizers as an agricultural input cannot be overemphasized in Nigeria, where the soils are quite low in nutrients. The application of fertilizers has been recognized as one of the quickest means of increasing farm output, and there is mounting evidence that the success of Nigeria on the food front will depend on increasing the use of nutrients. In part, this view is based on the experience of countries that have launched successful Green Revolutions in which expanded use of fertilizers played a dominant role.

Fertilizer use in Nigeria dates back to the early fifties, but, at that time, only token quantities were applied. Fertilizers were imported, and procurement and distribution were decentralized, with each region ordering its own supplies through the Regional Ministries of Agriculture. Suppliers delivered the nutrients either to the ports or directly to the regional fertilizer depots. The Regional Ministry then distributed them through sales commission agents. When the states were established, the State Governments inherited this system.

In 1976, the Federal Government of Nigeria centralized fertilizer procurement and distribution. The Federal Ministry of Agriculture assumed full responsibility for fertilizer procurement and distribution to the States. Consumption increased steeply, from about 50,000 tons in 1976 to over 1,000,000 tons in the 1981 crop season. Table 1 shows the quantity of fertilizers requisitioned and supplied from 1977 to 1983.

<table>
<thead>
<tr>
<th>Year</th>
<th>Requisitioned</th>
<th>Supplied</th>
</tr>
</thead>
<tbody>
<tr>
<td>1976</td>
<td>-</td>
<td>50,000</td>
</tr>
<tr>
<td>1977</td>
<td>461,141</td>
<td>290,902</td>
</tr>
<tr>
<td>1978</td>
<td>343,359</td>
<td>188,000</td>
</tr>
<tr>
<td>1979</td>
<td>493,024</td>
<td>362,320</td>
</tr>
<tr>
<td>1980</td>
<td>581,820</td>
<td>405,872</td>
</tr>
<tr>
<td>1981</td>
<td>1,074,210</td>
<td>1,041,779</td>
</tr>
<tr>
<td>1982</td>
<td>925,656</td>
<td>620,077</td>
</tr>
<tr>
<td>1983</td>
<td>1,158,731</td>
<td>506,604</td>
</tr>
<tr>
<td>1984</td>
<td>1,505,004</td>
<td>895,000 (est.)</td>
</tr>
</tbody>
</table>

Source: Federal Ministry of Agriculture.
To improve the efficiency of fertilizer procurement and distribution, a Fertilizer Procurement and Distribution Division was established in April 1979. It has the following functions:

- To determine the types and quantities of fertilizers needed by the States and agricultural projects.
- To procure good quality fertilizers at the cheapest prices possible.
- To arrange shipment of the fertilizers to the main Nigerian ports and transport them to specified depots in the States and agricultural project areas.
- To procure fertilizers manufactured by Government companies in Nigeria and arrange transportation to specified depots.
- To monitor the distribution of purchased fertilizers.

II. DOMESTIC FERTILIZER PRODUCTION

Nigeria currently has only one small fertilizer plant—a 100,000 tons a year single super phosphate plant (18% P$_2$O$_5$) at Kaduna commissioned in 1976. Its actual production has, however, been low, varying between 20,000 tons to 45,000 tons a year because of technical and managerial problems and bottlenecks in the transportation system.

The agronomic characteristics of Nigeria indicate large requirements of nitrogenous fertilizers. With its vast reserves of natural gas (both associated and non-associated gas), Nigeria is well-placed to establish a major nitrogen-based fertilizer industry to meet its requirements. A couple of projects are being undertaken to develop the industry.

III. FERTILIZER PRICING POLICY

Nigeria currently imports all its requirements for nitrogenous, phosphatic and potash fertilizers. The Kaduna single super phosphate plant meets only part, but not all, of Nigeria's phosphate fertilizer needs. The Government fixes fertilizer prices by statute; the policy is to sell the fertilizers to farmers at uniform prices throughout the country.

The objectives of the fertilizer pricing policy are to:

- Create an awareness of the importance of fertilizers and their technical and economic benefits.
- Make fertilizers available to more farmers.
Buildup of Costs, Margins and Prices

The buildup of costs involves port clearing charges and transportation. The former come to Nairas 15 (US$19.95) a ton of fertilizer. In Nigeria, the ports are situated in the south, while most of the fertilizers (about 80 percent) are consumed in the northern areas. Thus, the bulk of the fertilizers must be hauled great distances by road from the ports to the primary distribution centers. The average rate is Nairas 60 (US$80) a ton. Intra-State transportation, storage, handling and retailing costs account for an additional Nairas 35 (US$46) a ton.

The Government subsidizes domestic fertilizers at both the producers' and the farmers' level, while imported fertilizers are subsidized at the farmers' level. During 1976-78, the subsidy amounted to 75 percent of the c.i.f. fertilizer import price and port clearance charges and transportation costs to State warehouses. The farmers paid the remaining 25 percent. State Governments bore the cost of internal distribution within the States. In 1979/80, the Government reduced its subsidy to 50 percent and called on the States to bear 25 percent plus the cost of internal distribution. Farmers were to absorb the remaining 25 percent. The State Governments proved unable to meet their share, and the Federal Government ended up absorbing the entire subsidy. The total subsidy paid by both the Federal and State Governments between 1977 and 1983 was Nairas 511.9 million (US$680.8 million) (Table 2). Recently, the Government decided to reduce the entire fertilizer subsidy to 50 percent, beginning with the 1984 crop year. Its share is fixed at 35 percent, the States' share at 15 percent. Farmers are to absorb the remaining 50 percent (Table 3). The Government has also decided to commercialize the procurement and marketing of fertilizers.

Table 2: TOTAL SUBSIDY PAID BY THE FEDERAL AND STATE GOVERNMENTS, 1977-83
(in Nairas millions)a/

<table>
<thead>
<tr>
<th>Year</th>
<th>Federal subsidy (50%)</th>
<th>State subsidy (25%)</th>
<th>Total subsidy (75%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1977</td>
<td>26.54</td>
<td>13.27</td>
<td>39.81</td>
</tr>
<tr>
<td>1978</td>
<td>20.24</td>
<td>10.12</td>
<td>30.36</td>
</tr>
<tr>
<td>1979</td>
<td>25.94</td>
<td>12.47</td>
<td>38.41</td>
</tr>
<tr>
<td>1980</td>
<td>28.40</td>
<td>14.20</td>
<td>42.60</td>
</tr>
<tr>
<td>1981</td>
<td>122.32</td>
<td>61.16</td>
<td>183.48</td>
</tr>
<tr>
<td>1982</td>
<td>67.40</td>
<td>33.70</td>
<td>101.10</td>
</tr>
<tr>
<td>1983</td>
<td>50.57</td>
<td>25.58</td>
<td>76.15</td>
</tr>
<tr>
<td>Total</td>
<td>341.41</td>
<td>170.50</td>
<td>511.91</td>
</tr>
</tbody>
</table>

a/ 1 Naira = US$1.33.

Source: Federal Ministry of Agriculture.
Retail Prices for Fertilizer Products

The formula used to determine the retail prices for various fertilizer products includes the following items: product costs (c.i.f.), port clearing charges, inter-State transportation and handling costs, and intra-State transportation and handling costs. The product costs are based on the prevailing world market prices, while the port clearing charges involve harbor dues, wharfage and stevedoring charges. Table 3 shows the farmgate prices paid by the farmers between 1980-84. It reveals that the fertilizer prices to farmers increased steadily, even though the level of the Federal/State subsidy remained at 75 percent. For example, a 50 kg. bag of ammonium sulphate cost farmers Nairas 1.8 in 1980, Nairas 2.1 in 1981 and nairas 2.5 in 1983. This rise was the result of a gradual increase in both the landed cost of fertilizers and transportation costs within the country. Currently, the Government is pursuing a blanket approach to fertilizer subsidies in the sense that it is not selective as to types of farmers, kinds of crops and types of fertilizers. The pricing and subsidy policy of the Federal Government has been successful in that fertilizers are widely used, and there has been a increase in consumption over the years.

Table 3: FERTILIZER PRICES
(Nairas per 50 kg.) a/

<table>
<thead>
<tr>
<th></th>
<th>1980</th>
<th>1981 (with 75% subsidy)</th>
<th>1982</th>
<th>1983 (with 50% subsidy)</th>
<th>1984</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonium sulphate</td>
<td>1.80</td>
<td>2.10</td>
<td>2.32</td>
<td>2.50</td>
<td>5.00</td>
</tr>
<tr>
<td>Calcium ammonium nitrate</td>
<td>1.80</td>
<td>2.20</td>
<td>2.30</td>
<td>3.30</td>
<td>5.00</td>
</tr>
<tr>
<td>Single super phosphate</td>
<td>1.80</td>
<td>1.88</td>
<td>2.32</td>
<td>2.40</td>
<td>5.00</td>
</tr>
<tr>
<td>Urea</td>
<td>2.25</td>
<td>2.70</td>
<td>2.78</td>
<td>3.25</td>
<td>6.00</td>
</tr>
<tr>
<td>Boronated super phosphate</td>
<td>1.80</td>
<td>1.95</td>
<td>2.45</td>
<td>2.48</td>
<td>5.00</td>
</tr>
<tr>
<td>NPK: (15-15-15)</td>
<td>2.20</td>
<td>2.82</td>
<td>2.98</td>
<td>2.98</td>
<td>6.00</td>
</tr>
<tr>
<td>NPK: (20-20-0)</td>
<td>2.20</td>
<td>2.54</td>
<td>2.95</td>
<td>2.95</td>
<td></td>
</tr>
<tr>
<td>NPK: (26-12-0)</td>
<td>2.20</td>
<td>-</td>
<td>2.95</td>
<td>2.95</td>
<td></td>
</tr>
<tr>
<td>NPK: (12-12-17+2 Mgo)</td>
<td>2.20</td>
<td>2.88</td>
<td>2.95</td>
<td>2.95</td>
<td>6.00</td>
</tr>
<tr>
<td>NPK: (18-18-7)</td>
<td>2.20</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>NPK: (20-0-20)</td>
<td>-</td>
<td>-</td>
<td>3.03</td>
<td>3.03</td>
<td></td>
</tr>
<tr>
<td>Muriate of potash</td>
<td>1.80</td>
<td>2.17</td>
<td>2.45</td>
<td>2.45</td>
<td>5.00</td>
</tr>
<tr>
<td>Ca MgSO4</td>
<td>2.25</td>
<td>2.89</td>
<td>2.89</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>DAP</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>6.00</td>
</tr>
</tbody>
</table>

a/ 1 Naira = US$1.33.

Source: Federal Ministry of Agriculture.
Ex-Factory and International Prices

The c.i.f. price of imported single super phosphate (SSP) in early 1984 was US$110.00 a ton, while the price for domestic SSP was Nairas 200 (US$260 a ton). The high cost of the locally produced fertilizer is attributable to a low rate of capacity utilization (less than 50 percent), the result of technical problems and the high cost of the imported phosphate rock.

Foodgrains Pricing Policy

The Federal Government established a Nigerian Grains Board in 1976 whose primary objective is to purchase surplus grains from farmers at prices fixed by the Technical Committee on Producers Prices (TCPP). In setting the price, the committee considers the production cost of particular grains. The fixed price is applicable only to surplus grains; supply and demand determine the normal price of grains in the free market.

Analysis of the costs and returns of some major food crops shows a direct relationship between the levels of the fertilizer subsidy, yields and crop returns. The higher the rate of the fertilizer subsidy, the higher is the rate of fertilizer use and, consequently, the level of output, other things being equal. On the one hand, there is an inverse relationship between the level of the subsidy and the total production cost: other things being equal, the higher the level of the subsidy, the lower the total production cost. Given the latter relationship, an optimal level of fertilizer subsidy induces greater fertilizer use that results in higher levels of output and, ultimately, of farm income. Table 4 shows the production costs, revenues and profits/losses under the 75 percent fertilizer subsidy during 1979-80.

IV. FUTURE PLANS

The potential for increased fertilizer consumption in Nigeria is substantial. The factors that favor it are: low soil fertility coupled with low levels of existing plant nutrient use and an assured production response, a favorable benefit-cost ratio, and the heavy dependence of new farm technology on increased use of fertilizers.

Under the Fourth National Development Plan (1981-85), increased fertilizer use is expected to contribute 60 percent of the targeted increase of 3.4 million tons of foodgrains by 1985. To achieve this, the Plan proposes an annual consumption level of 1.3 million tons of fertilizers, or 430,000 tons of nutrients by 1985.

A reduction in the fertilizer subsidy will reduce the consumption of fertilizers, as the majority of farmers are just beginning to use nutrients and distribution is inefficient. However, it might not affect consumption significantly if farmers have easy access to fertilizers and they are familiar with better farm practices for increasing output and their output prices increase more than proportionately to the reduction in
Table 4: PRODUCTION COSTS, REVENUES AND PROFIT (LOSS) PER TON OF MAJOR NIGERIAN GRAIN CROPS UNDER THE 75 PERCENT FERTILIZER SUBSIDY, 1979-80 (in Nairas)

<table>
<thead>
<tr>
<th>Crop</th>
<th>Average production costa/</th>
<th>Average total returns</th>
<th>Net returnsa/</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copeas</td>
<td>527.53</td>
<td>582.42</td>
<td>54.89</td>
</tr>
<tr>
<td></td>
<td>(542.85)</td>
<td>(39.57)</td>
<td></td>
</tr>
<tr>
<td>Guinea corn</td>
<td>312.92</td>
<td>319.17</td>
<td>6.25</td>
</tr>
<tr>
<td></td>
<td>(361.13)</td>
<td>(-14.96)</td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td>353.30</td>
<td>347.60</td>
<td>-5.70</td>
</tr>
<tr>
<td></td>
<td>(392.40)</td>
<td>(-44.80)</td>
<td></td>
</tr>
<tr>
<td>Millet</td>
<td>249.60</td>
<td>340.11</td>
<td>90.51</td>
</tr>
<tr>
<td></td>
<td>(282.72)</td>
<td>(57.39)</td>
<td></td>
</tr>
<tr>
<td>Rice (paddy)</td>
<td>340.25</td>
<td>437.82</td>
<td>97.57</td>
</tr>
<tr>
<td></td>
<td>(351.17)</td>
<td>(86.65)</td>
<td></td>
</tr>
<tr>
<td>Rice (milled)</td>
<td>357.45</td>
<td>699.82</td>
<td>342.37</td>
</tr>
<tr>
<td></td>
<td>(368.25)</td>
<td>(331.45)</td>
<td></td>
</tr>
<tr>
<td>Wheat</td>
<td>465.20</td>
<td>391.90</td>
<td>-73.30</td>
</tr>
<tr>
<td></td>
<td>(527.14)</td>
<td>(-135.24)</td>
<td></td>
</tr>
</tbody>
</table>

Note: 1 Naira = US$1.33.

a/ Figures in parentheses show costs without the fertilizer subsidy.

Source: Guaranteed Minimum Prices for Grain Crops in Nigeria, report prepared by the Department of Agricultural Economics, University of Ibadan, for the Federal Department of Agriculture, 1981.

the fertilizer subsidy. The Government could also encourage more fertilizer use not only through higher crop prices but also through adoption of better technology and improved access to agricultural credit. Improvements in the efficiency of procurement and distribution will save the Government money and thus both lower the cost that is passed on to farmers and reduce the subsidy. Moreover, to enhance efficient use, the right types of fertilizers need to be delivered on time, in the correct
amounts and for the right crops. There have been instances when fertilizers were delivered after the growing season.

The Government has recently become fully aware of the shortcomings of the existing fertilizer marketing and distribution system and pricing policies. Agencies such as the Fertilizer Procurement and Distribution Division of the Ministry of Agriculture, the River Basin Development Authorities and the Agricultural Development Projects have been handling sales and distribution. As they are not commercial ventures, they do not get a reasonable return on their investment. To overcome supply constraints, the Federal Government has decided to commercialize procurement, distribution and marketing beginning with the 1985 crop year. It is transferring these functions from the Federal Ministry of Agriculture to the National Fertilizer Company of Nigeria (NAFCON), established to produce ammonia-based fertilizers. Shortfalls between local production and demand will be met by imports. The company will appoint distributors and distribution supervisors to maintain depots throughout the country and will arrange delivery to the depots. Discounts for quantity, off-season and cash purchases to wholesalers and dealers will be used to boost sales. To ensure timely delivery of fertilizers to farmers, invitations for tender for the import of fertilizers and awards of contracts are made well in advance to allow for processing and distribution for the growing season. Shipping schedules are drawn up, and the Port Managers are instructed to give priority to fertilizer vessels. The fertilizers are transported promptly by road (truck), rail and barge to the primary distribution centers, where they are stored for final distribution to farmers. Over 130 primary distribution centers, each serving an area within a 10-kilometer radius, have been established around the country to allow for easy distribution.
Chapter 6

FERTILIZER PRICING POLICY IN PORTUGAL

L. R. Balbino
Deputy General Manager
QUIMIGAL
and M. Monteiro Marques
QUIMIGAL

I. STRUCTURE OF THE FERTILIZER INDUSTRY

The Portuguese fertilizer industry is essentially oriented toward the domestic market. Since 1970, about 85 percent of domestic production has been directed to domestic consumption, although in most years some nitrogenous fertilizers have been exported, at a level of 30,000-40,000 nutrient tons. Portugal has downstream facilities to produce finished fertilizers (e.g., ammonium nitrate), and also to produce intermediate goods (ammonia and nitric acid). Until 1977, Portugal's fertilizer industry consisted of five companies: (1) Companhia União Fabril (CUF), (2) Amoniaco Portugues S.A.R.L. (AMPOR), (3) Nitratos de Portugal S.A.R.L. (NP), (4) Sociedade Portuguesa de Petroquímica S.A.R.L. (SPP), and (5) S.A. de Produits et Engrais Chimiques du Portugal S.A.R.L. (SAPEC). Four of these five companies, which were owned by local private shareholders until 1974, were nationalized in 1975, as were most other large-scale industries in Portugal. In January 1978, CUF, AMPOR and NP were formally merged to form a national fertilizer company, Quimica de Portugal (QUIMIGAL). SPP has been incorporated into the energy sector. SAPEC remains in the private sector. Thus, at present, there are two domestic manufacturers: QUIMIGAL, which is state-owned and which accounts for 80 percent of domestic production; and SAPEC, which accounts for the remaining 20 percent. SAPEC uses naphtha, a high-price feedstock, to produce ammonia, an intermediate product for fertilizer manufacture, whereas the new QUIMIGAL plant uses fuel oil and/or vacuum residue, a less expensive feedstock.

As there are no independent bulk blending facilities in Portugal, the fertilizer producers prepare various fertilizer formulations and sell the final products. The bulk of the distribution is carried out by some 3,000 independent retailers who receive the fertilizers from the producers' warehouses in the field or directly from the factories.

II. PRICING POLICY

Pricing and Consumption

Fertilizers have long been considered indispensable for agricultural production in Portugal. Nitrogen has been the most important
nutrient, accounting now for about 55 percent of total fertilizer use. Because of their impact on the farm sector, fertilizer prices have received special attention. Nevertheless, fertilizer consumption in Portugal per unit of arable land has for quite some time been one of the lowest among European countries, including those with similar land, climate and agricultural conditions. One result has been large deficits in food production. It has, therefore, long been a concern that prices not be an obstacle to consumption.

From 1963/64 to 1972/73, prices were kept relatively constant, as the figures (relative indices) below show:

<table>
<thead>
<tr>
<th></th>
<th>1963/64</th>
<th>1972/73</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>100</td>
<td>91</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>100</td>
<td>95</td>
</tr>
</tbody>
</table>

During this period, the pricing system was structured as follows. Fertilizer prices were established by the Government, but were not subsidized. Ex-factory prices were set roughly in line with the c.i.f. international prices of imports. The Government also set the prices for some inputs—naphtha, fuel oil and electric power. Because of the importance of phosphorus to the Portuguese soil, the Government did grant a small subsidy for rock phosphate. It also set the prices of bags as well as the transportation costs and commercialization margins. The sales price to the retailer was then based on the ex-factory price plus transportation costs to the railway station nearest to the retailer or, if trucks were used, to the retailer's warehouse. Final sales prices to farmers were adjusted in such a way that they were practically uniform everywhere in the country.

Major changes in the dynamics of fertilizer prices occurred in 1974 and 1975 for two reasons:

- The large increase in the prices of raw materials, particularly oil, rock phosphates and potash, and
- The revolution of April 1974 in Portugal.

The increase in raw material prices led to a rise of about 80 percent in the selling price to farmers in the agricultural year 1974/75. The result was a 22 percent decrease in consumption. Phosphorus was affected the most: its sales dropped by 25 percent in the face of a price increase of 130 percent (see Figure 1). (An identical phenomenon occurred in several European countries, the extreme case being Ireland, where a 40 percent drop took place.)
Figure 1:
PORTUGAL
Total Fertilizer Consumption

Note: From 1961, the years refer to agricultural years.
Since it was impossible to check the rise in the cost of raw materials, some countries established subsidies for fertilizers in order to avoid drastic decreases in consumption and, consequently, in food production. Portugal enacted a 30 percent subsidy, equivalent to Escudos (Esc.) 300 million, in 1975/76 to encourage fertilizer use and to maintain an adequate price ratio between nutrients and crops. Consumption rose by 31 percent (see Figure 1). Although several other factors contributed to this increase—new prices were set for agricultural commodities, more farm credit was made available and a food production campaign was initiated—the reduction in fertilizer prices was decisive.

A further increase in prices was authorized in November 1976. In May 1977, the nationalized company, QUIMIGAL, called for yet another change in prices. After considering it, the Government proposed an average increase of 22 percent, while holding constant the price of ammonia. However, in July 1977, the Government decided not to raise the fertilizer prices to farmers. Thus, in view of the rising input prices, the subsidy rose to an estimated Esc. 1,900 million in 1977/78, up from Esc. 900 million in 1976/77.

Fertilizer producers were compensated directly for the farmers' subsidy through the Government's Fundo de Abastecimento (Department of Subsidies) on the basis of sales invoices they presented. One recurring problem was delayed payment of the subsidies because the Fundo was short of cash. The situation caused serious financial problems in the industry.

During 1978/79, industrial costs went up by 30 percent. The sales prices to farmers were allowed to increase by 38 percent, a very dramatic rise that affected consumption (Figure 1). The Fundo de Abastecimento paid 36 percent of the fertilizer prices and the farmers paid the remaining 64 percent. The subsidy amounted to about Esc. 2,500 million.

In 1979/80, the increase in input prices continued, but the Government decided not to raise the fertilizer prices for farmers. It maintained the subsidies for fertilizers and, in the case of the Azores and Madeira Islands, absorbed the transportation costs as well. Between 1980/81 and 1982/83, the Government revised some of the criteria for fixing fertilizer prices. This led to changes in the prices received by manufacturers and paid by farmers (Table 1).

In 1983, the Government adopted a new policy which said, in part:

The need to contain subsidies makes it indispensable to take steps with a view to the progressive reduction of the same in the fertilizer sector...In fact, the existing selling prices, quite lower than costs, give rise to high losses covered by public funds and become progressively different from prices existing in the Southern European countries.

In sum, the Government saw a need to eliminate the subsidy both to reduce the burden on the budget and to bring prices in line with those in Southern Europe.
Table 1: THE EVOLUTION OF FERTILIZER PRICES

<table>
<thead>
<tr>
<th>Year (month)</th>
<th>Index</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Industry (1)</td>
<td>Farmer (2)</td>
</tr>
<tr>
<td>1974 (August)</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1975 (August)</td>
<td>110</td>
<td>70</td>
</tr>
<tr>
<td>1976 (November)</td>
<td>120</td>
<td>90</td>
</tr>
<tr>
<td>1977 (July)</td>
<td>160</td>
<td>90</td>
</tr>
<tr>
<td>1978 (September)</td>
<td>194</td>
<td>124</td>
</tr>
<tr>
<td>1979 (July)</td>
<td>226</td>
<td>124</td>
</tr>
<tr>
<td>1980 (November)</td>
<td>328</td>
<td>164</td>
</tr>
<tr>
<td>1981 (October)</td>
<td>433</td>
<td>236</td>
</tr>
<tr>
<td>1982 (August)</td>
<td>655</td>
<td>342</td>
</tr>
<tr>
<td>1983 (June)</td>
<td>1,057</td>
<td>602</td>
</tr>
</tbody>
</table>

Source: QUIMIGAL.

Current Pricing Policy

One result of this policy was a further and significant change in the criteria for setting prices. In the beginning of 1983/84, the subsidy for the ammonia used in manufacturing fertilizers was eliminated. The price of this intermediate product, produced from naphtha, increased sharply from Esc. 20,000 to Esc. 47,212\(^1\) a ton. As a consequence, the price of fertilizers to farmers went up on an average by about 75 percent. Although the increase is accompanied by some increases in the prices of cereals, fertilizer consumption is expected to drop between 20 and 25 percent.

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\(^1\) Currently US$1 = Esc. 139.49.
At present, a governmental commission that includes representatives of several ministries, among them industry, finance, commerce and agriculture, sets the ex-factory fertilizer prices every year. The commission determines the production costs of the two domestic manufacturers, QUIMIGAL and SAPEC, taking into account raw material and transportation costs and interest charges on capital. The price is then based on the lower of the costs of the two producers, allowing a profit margin of 4.6 percent on the value of sales in the domestic market.

Table 2 gives the ratio between farmers' prices for fertilizers and wheat. The highest increase in fertilizer prices in relation to wheat prices came in 1974/75, the year of the revolution. The year 1979/80 reflects a sharp increase in the price of wheat in relation to the prices of N and P₂₀₅ nutrients.

Table 2: RATIOS BETWEEN FARMERS' PRICES FOR FERTILIZERS AND WHEAT

<table>
<thead>
<tr>
<th>Campaign</th>
<th>Price of 1 kg. N</th>
<th>Price of 1 kg. P₂₀₅</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973/74</td>
<td>2.12</td>
<td>1.53</td>
</tr>
<tr>
<td>1974/75</td>
<td>2.89</td>
<td>2.60</td>
</tr>
<tr>
<td>1975/76</td>
<td>1.90</td>
<td>1.72</td>
</tr>
<tr>
<td>1976/77</td>
<td>2.16</td>
<td>1.94</td>
</tr>
<tr>
<td>1977/78</td>
<td>1.76</td>
<td>1.58</td>
</tr>
<tr>
<td>1978/79</td>
<td>1.92</td>
<td>1.72</td>
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<tr>
<td>1979/80</td>
<td>1.32</td>
<td>1.21</td>
</tr>
<tr>
<td>1980/81</td>
<td>1.61</td>
<td>1.47</td>
</tr>
<tr>
<td>1981/82</td>
<td>1.84</td>
<td>1.67</td>
</tr>
<tr>
<td>1982/83</td>
<td>2.18</td>
<td>1.98</td>
</tr>
<tr>
<td>1983/84</td>
<td>2.51</td>
<td>2.09</td>
</tr>
</tbody>
</table>

Source: QUIMIGAL

Future Plans

While the overall pricing arrangements meet, in principle, the Government's objectives of giving a fair price to producers, the Government intends to phase out the subsidies, at the same time keeping the relative prices of fertilizers and crops attractive to farmers. Under the World Bank-financed Fertilizer Modernization Project, the Government is to study fertilizer subsidies within the context of the evolution of the prices and subsidies for agricultural crops and to consider how the rate of growth in fertilizer consumption can be maintained while reducing the subsidies.
III. CONCLUSIONS

Sharp increases in the retail prices of fertilizer could cause serious structural and social problems in both the fertilizer industry and the country. The goal is, therefore, to eliminate the subsidies gradually, thus making both the industry and agriculture competitive with foreign countries.
Chapter 7

GROWTH IN INDIAN FERTILIZER CONSUMPTION: PRICE AND NON-PRICE POLICIES

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Centre for Management in Agriculture,
Indian Institute of Management

This paper discusses fertilizer pricing policy in the context of the need to generate sustained rapid growth in India's fertilizer consumption. Section I provides a brief overview of past growth and future needs for consumption. Section II, which traces the evolution of fertilizer pricing policy, shows how and why this policy has been inseparable from, perhaps even deeply embedded in, fertilizer supply and distribution policies. It is necessary to understand this relationship in order to appreciate how the fertilizer subsidies of recent years have led to complexities in pricing policy. Section III highlights major non-price policies. These appear to be even more crucial than price policy in raising India's fertilizer consumption rapidly and continuously.

I. FERTILIZER CONSUMPTION

Fertilizer began to be used in appreciable quantities in the 1920s on the tea plantations. However, although the low fertility of Indian soils had been recognized since the 1890s, application of fertilizers did not expand much beyond these plantations, and the Government did nothing to push it. This situation changed in 1943, when the Grow More Food Campaign was launched in the wake of the Japanese occupation of Burma, from which India imported rice, and the Bengal Famine. The measures taken then marked the beginning of efforts to promote fertilizer use in the non-plantation sector in order to raise food production rapidly. These efforts gathered momentum after India became independent in 1947. (For a historical perspective, see Desai, 1969, chapter 2; Desai, 1979.)

In the late 1940s, India was using less than 50,000 tons of nutrients in the form of chemical fertilizers (i.e., less than 0.5 kg. a hectare). By 1965-66, consumption had grown to about 300,000 tons, by 1973/74, 2.8 million, and by 1983-84, more than 7 million (Table 1). India now ranks fourth in total fertilizer consumption after the United States, the USSR and China. 1/

1/ While India's rank is attributable to its large size, the same is true of the United States, the USSR and China, all of which, however, rank much lower on a per hectare basis. Of importance is that neither China nor India were in the top 15 countries until the 1960s. India's record in raising its consumption from less than 1 kg. a hectare in the early 1950s to 41 kg. by 1983/84 is quite impressive when compared with the time taken by many developing and developed countries to raise their per hectare fertilizer consumption in this range. On the other hand, India's growth performance is considerably poorer than China's.
### Table 1: CONSUMPTION OF FERTILIZERS IN INDIA, 1951-52 to 1983-84

<table>
<thead>
<tr>
<th>Year</th>
<th>Consumption ((^000) tons)</th>
<th>Per hectare consumption a/ (kgs.)</th>
<th>Annual change in total consumption</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>P(<em>{2})O(</em>{5})</td>
<td>K(_{2})O</td>
<td>Total</td>
</tr>
<tr>
<td>1951-52</td>
<td>59</td>
<td>7</td>
<td>8</td>
<td>74</td>
</tr>
<tr>
<td>1952-53</td>
<td>58</td>
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<td>66</td>
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<td>1953-54</td>
<td>89</td>
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<td>8</td>
<td>105</td>
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<tr>
<td>1954-55</td>
<td>95</td>
<td>15</td>
<td>11</td>
<td>121</td>
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<td>1955-56</td>
<td>108</td>
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<td>1967-68</td>
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<td>335</td>
<td>170</td>
<td>1,540</td>
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<td>1968-69</td>
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<td>1,761</td>
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<td>1969-70</td>
<td>1,356</td>
<td>416</td>
<td>210</td>
<td>1,982</td>
</tr>
<tr>
<td>1970-71</td>
<td>1,479</td>
<td>541</td>
<td>236</td>
<td>2,256</td>
</tr>
<tr>
<td>1971-72</td>
<td>1,798</td>
<td>558</td>
<td>300</td>
<td>2,656</td>
</tr>
<tr>
<td>1972-73</td>
<td>1,839</td>
<td>581</td>
<td>348</td>
<td>2,768</td>
</tr>
<tr>
<td>1973-74</td>
<td>1,830</td>
<td>650</td>
<td>360</td>
<td>2,840</td>
</tr>
<tr>
<td>1974-75</td>
<td>1,766</td>
<td>472</td>
<td>336</td>
<td>2,574</td>
</tr>
<tr>
<td>1975-76</td>
<td>2,149</td>
<td>467</td>
<td>278</td>
<td>2,894</td>
</tr>
<tr>
<td>1976-77</td>
<td>2,457</td>
<td>635</td>
<td>319</td>
<td>3,411</td>
</tr>
<tr>
<td>1977-78</td>
<td>2,913</td>
<td>867</td>
<td>506</td>
<td>4,286</td>
</tr>
<tr>
<td>1978-79</td>
<td>3,420</td>
<td>1,106</td>
<td>592</td>
<td>5,118</td>
</tr>
<tr>
<td>1979-80</td>
<td>3,499</td>
<td>1,150</td>
<td>607</td>
<td>5,256</td>
</tr>
<tr>
<td>1980-81</td>
<td>3,678</td>
<td>1,214</td>
<td>624</td>
<td>5,516</td>
</tr>
<tr>
<td>1981-82</td>
<td>4,069</td>
<td>1,322</td>
<td>676</td>
<td>6,067</td>
</tr>
<tr>
<td>1982-83 b/</td>
<td>4,263</td>
<td>1,420</td>
<td>735</td>
<td>6,418</td>
</tr>
<tr>
<td>1983-84 c/</td>
<td>4,750</td>
<td>1,619</td>
<td>811</td>
<td>7,180</td>
</tr>
</tbody>
</table>

a/ Based on "gross cropped area." Estimates for the last five years are based on the gross cropped area in 1978-79.

b/ Provisional.

c/ Estimated.

The need for substantial further growth in consumption is indicated by India's relatively low level of consumption per hectare as compared to the levels in countries with high crop yields. More important, it is revealed by future requirements for agricultural production, most of which will have to come from continuous increases in yields per hectare. Those increases in turn will depend in part on fertilizer use. For instance, according to the National Commission on Agriculture, about 80 percent of the additional foodgrain production required by the year 2000 will depend on increased use of fertilizers.

This dependence on fertilizers is stressed because it highlights a simple axiom: soil fertility ultimately determines the limits of growth in yields, whether on irrigated or unirrigated areas and with or without improvements in crop varieties. The widespread deficiency of nitrogen in Indian soils is well-known, but the availability of phosphorus and potash is also low, and there is growing evidence of a deficiency in sulphur as well as in micro-nutrients at a number of locations. Obviously, growth in agricultural production based on yield cannot be sustained without

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2/ This disparity is clear from the data on yields of different crops and fertilizer consumption per hectare of arable land in the FAO's Production Yearbook and Fertilizer Yearbook, respectively. It may be noted, however, that comparisons of fertilizer consumption per hectare of arable land based on the FAO's data exaggerate the differences between India and many other countries. This exaggeration is most notable in countries such as some in Europe and in Australia and New Zealand, where a substantial proportion of total fertilizer consumption is on pasture land, and in those countries with a high degree of multiple cropping, as in some Asian countries, including China. In India, there is hardly any fertilizer use for hay and pastures. The data for India in the FAO statistics relate to gross cropped areas (which includes multiple cropped areas), whereas those for many other countries, including China, relate to arable land, which excludes multiple cropped areas.

3/ The estimates made by the National Commission on Agriculture show that 102 million out of 126 million tons of additional foodgrain production will depend on greater fertilizer consumption. Against this, increased irrigation, the development of irrigated areas and the program of dry farming together are estimated at 24 million tons. For details, see India, Ministry of Agriculture and Irrigation (1976, pp. 75-80).

4/ Randhawa and Tandon (1982). See also other articles in the special issue of Fertiliser News (February 1982), brought out on the occasion of the 12th International Congress of Soil Science, held in New Delhi on February 8-16, 1982.
removing these constraints. Hence, there is general agreement on the importance of continuously raising fertilizer use. 5/

The estimates of required fertilizer use in India by the year 2000 vary between 15 and 20 million tons. 6/ To achieve those levels, total consumption must go up by 450 thousand to 750 thousand tons every year during the 1980s and 1990s. So far, the annual increment in fertilizer consumption has exceeded 500 thousand tons only 5 times. 7/ It is, therefore, pertinent to ask what must be done to generate the desired growth in fertilizer use.

To discuss that question meaningfully, it is necessary to understand the forces behind past growth and the constraints on raising fertilizer consumption at the desired speed. Fertilizer prices are obviously important, but they are only one factor. Also important are such considerations as crop prices, responses of crops to fertilizer use, the untapped potential for fertilizer use and how it is changing in light of the upward shifts in fertilizer response functions, and the workings of the fertilizer supply and distribution, as well as the agricultural research, extension and credit, systems.

These considerations are stressed because fertilizer prices and price policy are becoming increasingly important in policy discussions on sustained rapid growth in consumption. More often than not, such discussions are headed by the rising burden of fertilizer subsidies and an apprehension that raising fertilizer prices to lower the subsidies will adversely affect the growth of consumption.

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5/ While chemical fertilizers are only one source of plant nutrients, they have become increasingly important, as revealed by experience in India and elsewhere. Even China, with its exemplary performance in mobilizing other sources of nutrients, has found this. See Tang and Stone (1980, especially p. 47).

6/ For example, see the estimates made by the National Commission on Agriculture and UNIDO. For the commission's estimates, see the source cited in footnote 3. For UNIDO's estimates, see UNIDO (1976, chapter 2).

7/ This dimension is clearer when looked at in absolute rather than percentage terms because of the vast changes in the base level. For instance, a 5 to 7 percent rate of growth in fertilizer consumption is needed to raise the present level to 15 to 20 million tons by the year 2000. In 23 of the last 32 years, fertilizer use grew by a rate considerably higher than 7 percent. Viewed thus, the task does not appear formidable. However, now a 5 to 7 percent growth rate implies increments of consumption greater than 500,000 tons a year. In only 5 of 32 years was that level of increments in consumption achieved. The task no longer seems all that easy.
The burden of fertilizer subsidies on the budget has in fact grown rapidly (Table 2). In 1983-84, it reached Rs. 10,480 million, or 2.7 percent of the total disbursements of the central government. A recent article in The Economic Times contends that the fertilizer subsidy is considerably larger (Rs. 14,000 million) than stated in the budget statistics, since the domestic fertilizer industry is charged lower prices for naphtha and fuel oil than other industries. It further contends that fertilizer subsidies will rise to Rs. 70,000 million by 1990 unless the retail prices of fertilizers are raised. While not everyone accepts all the arguments and estimates in the article, there is general agreement that the burden of the fertilizer subsidy will grow over time as fertilizer consumption increases. However, there is no consensus on whether the retail prices of fertilizers should be raised.

As shown in Table 2, most of the present burden of fertilizer subsidies is from domestic fertilizers under the Fertilizer Retention Price Scheme. In this scheme, the Government pays manufacturers the difference between the retail prices and delivery costs of fertilizers to them. Thus, the fertilizer subsidies could be reduced either by raising the retail prices of fertilizers or lowering the prices paid to the fertilizer manufacturers. It is argued that raising the retail prices will adversely affect fertilizer consumption, on which the targets for agricultural production depend. Given the upward pressure on the cost of fertilizer production, and the industry's claim that even present prices are not enough to ensure a fair return on investment, there is virtually no apparent scope for lowering the retention prices. Moreover, the Government's policy is to meet increasing proportions of the fertilizer requirements through domestic production. Thus, any simpleminded policy of lowering the retention prices will be self-defeating, especially if it constrains further development of the domestic fertilizer industry.

Clearly, there are valid reasons for concern about fertilizer prices and price policy. It would be unfortunate, however, if they were to dominate the policy discussions on sustained rapid growth in fertilizer consumption. Fertilizer prices (in either nominal or real terms) are only one set of variables governing growth in fertilizer consumption. In fact, evidence shows clearly that they have been much less important than many other non-price variables and policy instruments. Further, fertilizer pricing policy involves many more issues than either subsidies or oversimplified relationships between fertilizer prices and growth in usage. A lot more systematic research is needed on the real burden of fertilizer subsidies and its rationale before it is possible to take a prudent position on the extent to which the present magnitude of fertilizer subsidies should govern fertilizer pricing policy. In fact, a few points emerging from the historical perspective presented in the next section indicate the complexity of the issues and suggest that India's record on fertilizer pricing policy may not be as dismal as it seems from the present burden of the subsidies.

<table>
<thead>
<tr>
<th>Year</th>
<th>Imported fertilizers b/</th>
<th>Domestic fertilizers c/</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1971-72</td>
<td>-20</td>
<td>-</td>
<td>-20</td>
</tr>
<tr>
<td>1972-73</td>
<td>-18</td>
<td>-</td>
<td>-18</td>
</tr>
<tr>
<td>1973-74</td>
<td>33</td>
<td>-</td>
<td>33</td>
</tr>
<tr>
<td>1974-75</td>
<td>371</td>
<td>-</td>
<td>371</td>
</tr>
<tr>
<td>1975-76</td>
<td>242</td>
<td>-</td>
<td>242</td>
</tr>
<tr>
<td>1976-77</td>
<td>52</td>
<td>60</td>
<td>112</td>
</tr>
<tr>
<td>1977-78</td>
<td>159</td>
<td>107</td>
<td>266</td>
</tr>
<tr>
<td>1978-79</td>
<td>169</td>
<td>173</td>
<td>342</td>
</tr>
<tr>
<td>1979-80</td>
<td>282</td>
<td>321</td>
<td>603</td>
</tr>
<tr>
<td>1980-81</td>
<td>335</td>
<td>170</td>
<td>505</td>
</tr>
<tr>
<td>1981-82</td>
<td>100</td>
<td>275</td>
<td>375</td>
</tr>
<tr>
<td>1982-83 RE</td>
<td>98</td>
<td>550</td>
<td>648</td>
</tr>
<tr>
<td>1983-84 RE</td>
<td>148</td>
<td>900</td>
<td>1,048</td>
</tr>
<tr>
<td>1984-85 BE</td>
<td>150</td>
<td>930</td>
<td>1,080</td>
</tr>
</tbody>
</table>

RE = Revised; BE = Budget estimates.

a/ Rs. 1 crore = Rs. 10 million.

b/ These data appear in the capital account of the budget. Details regarding subsidies, losses and changes in inventory are not available separately. These figures, however, are referred to as subsidies for imported fertilizers even in official documents. For example, see Reserve Bank of India, Report on Currency and Finance, 1982-83, volume 1, pp. 35-36.

c/ These data include: (1) payments under the Fertiliser Retention Price Scheme to manufacturers of nitrogenous and phosphatic fertilizers; (2) payment of subsidies to indigenous manufacturers of single super phosphate; and (3) payments under the Fertiliser Freight Subsidy Scheme. In 1983-84, Rs. 690 crores were paid under (1); Rs. 25 crores under (2); and Rs. 185 crores under (3).

Sources: Compiled from Report of the Committee on Controls and Subsidies, May 1979; and budget documents.
II. FERTILIZER PRICES AND PRICE POLICY

Whereas substantial fertilizer subsidies are relatively recent, the Government has always controlled the prices of fertilizers one way or another since 1943. What led to these controls? How did they change over time, and why? What was the resulting environment with respect to fertilizer prices? How did it affect the growth of consumption? Which factors have led to the growing burden of fertilizer subsidies?

Questions like these are addressed below. It is important to note that these questions are especially difficult to answer in the Indian context for two reasons. First, historically, fertilizer price policy has been inseparable from fertilizer supply and distribution policy. Perhaps, it has even been deeply embedded in it. Second, supply and distribution policies have been governed on the one hand by the objective of raising food production rapidly, and on the other by the drives and constraints inherent in the strategy adopted to pursue economic development and industrialization in a large country. These points cannot be overemphasized since they help in understanding not only the evolution but also the present dilemma in fertilizer pricing policy.

When in 1943 the Government launched the Grow More Food Campaign to raise food production rapidly, the most severe constraint was the limited availability of fertilizers. In the late 1930s, imports constituted over 80 percent of the nutrients used, and this was mainly in the plantation sector. As World War II gathered momentum, the export surplus on the world market dwindled sharply, and so did India's imports. The International Emergency Food Council allocated those exports to various Governments. To import the fertilizers assigned to India and to ensure their availability to the non-plantation sector, in 1944 the Government established a Central Fertiliser Pool in the Ministry of Food and Agriculture. The Pool also procured all the domestic production of nitrogenous fertilizers. The total supply was then distributed to the provincial Governments for distribution to cultivators in the non-plantation sector, to boards representing tea, coffee and rubber plantations, and to industrial users. Prices were fixed on a no-profit, no-loss basis. This program was the beginning of price controls on fertilizers. It originated from supply constraints and a desire to ensure that some supplies went to the non-plantation sector to promote a rapid increase in food production there.

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9/ For the origin, objectives and operations of the Central Fertiliser Pool, see India (1960, chapter II) and India (1965, Annexure IX).
This system continued after independence in 1947, even though public investments in the fertilizer industry had started enlarging domestic capacity. The main reasons were the need to control supplies in light of the foreign exchange constraints on liberal imports of fertilizers, concern for equitable distribution among the States to achieve food production targets (fertilizers were assigned increasing importance over time in achieving these targets), and a preference for cooperative institutions in the fertilizer distribution system (because of their widespread network and the policy of channeling agricultural production credits through them).

Until 1953, the prices the Central Fertiliser Pool set for fertilizers did not include railway freight, which was borne by the consignees. This exclusion resulted into unequal prices at different locations and was considered unconducive to growth in fertilizer consumption at distant locations. The Government decided to charge uniform prices, to be accomplished by including equated railway freight in the prices. After 1953, the prices took into account the landed cost of imported fertilizers, the cost of procuring domestic fertilizers, handling charges at ports for imported fertilizers, interest for six months on capital invested in imports, incidental and overhead charges, equated railway freight, excise duties and the prescribed margins for wholesalers and retailers. The retention prices of domestic fertilizers procured by the Central Fertiliser Pool were fixed by the Cost Accountancy Division of the Ministry of Finance based on the costs of production and a fair return on investment by manufacturers.

For a brief period between 1948 and 1952, this policy of pooling supplies was also applied to phosphatic fertilizers. This step was taken because domestic manufacturers were calling for protection against

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10/ The foreign exchange constraints on liberal imports of fertilizers were not unique to India among developing countries. What was perhaps unique was India's strategy for economic development and industrialization, which made the constraints more severe and persistent.

11/ This policy has persisted. The Fertiliser Freight Subsidy Scheme introduced in 1979 is the latest concrete expression of the policy of uniform prices.
imports. The price paid to the domestic factories was based on a formula evolved by the Tariff Board, which reflected changes in the prices of rock phosphate and sulphur.

Although the pooling arrangements were discontinued for phosphatic nutrients after 1952, the Government continued to fix ex-factory prices until 1966, when it assigned this task to the Fertiliser Association of India. Supplies of phosphatic fertilizers were obtained either by the State Governments or by the apex cooperative societies directly from the factories and were distributed through government depots or cooperative societies. In a few States, distribution was handled by the manufacturers through their own agents (either private traders or cooperative societies). The delivered cost of phosphatic fertilizers differed according to the distance from the supplying factories. In some States, retail prices were fixed at a uniform level by pooling the transportation costs and adding a uniform distribution margin to the railhead prices (India, 1960 and 1965). To promote the use of phosphatic fertilizers, the central Government introduced a subsidy, initially of 50 percent and later of 25 percent. The cost of the subsidy was to be shared equally by the central and State Governments. However, only some State Governments participated in this scheme to promote the use of phosphatic fertilizers through subsidizing them.

Potassic fertilizers were imported by the State Trading Corporation through the Indian Potash Supply Agency. Uniform export prices were fixed by pooling the cost of imports, the handling and administration charges and the profit margin for the Supply Agency. There was, however, no control over the retail selling prices.

This price and distribution policy continued until the mid-1960s. There was very little use of the fertilizer subsidy, which made India somewhat unique among developing countries in the 1950s and 1960s. In the case of nitrogenous fertilizers (which constituted more than 75 percent of total consumption), the subsidy was confined mainly to off-season rebates, transportation to hilly and inaccessible areas, and, in a few States, to the introduction of new fertilizers. Not only was the subsidy bill small, but the Central Fertiliser Pool made a profit in 18 out of the 20 years between 1944-45 and 1963-64 (Table 3), amounting to Rs. 434 million. In 1963-64, the Public Accounts Committee criticized this because a sizable recurring profit was not consistent with the no-profit, no-loss concept underlying the pool prices of fertilizers. The Committee on Fertilisers made the same criticism in 1965. The complaints assumed added importance in light of the fact that the prices of fertilizers were quite high not only in nominal terms, but also in real terms (Table 4), and there was no major price support program for crops.\(^{12/}\)

\(^{12/}\) For the relative importance and influence of price variables vis-a-vis non-price variables such as irrigation and cropping patterns in the growth and use of fertilizers until 1965, see Desai (1969).
Table 3: PROFITS AND LOSSES UNDER THE SCHEME FOR THE PURCHASE OF CHEMICAL FERTILIZERS, 1944-45 to 1963-64

<table>
<thead>
<tr>
<th>Year</th>
<th>Net profit or loss a/ (Rs.)</th>
<th>Distribution ('000 tons)</th>
<th>Profit or loss per ton (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>P2O5</td>
</tr>
<tr>
<td>1944-45</td>
<td>671,583</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1945-46</td>
<td>2,564,061</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1946-47</td>
<td>-440,316</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1947-48</td>
<td>1,429,857</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1948-49</td>
<td>142,639</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1949-50</td>
<td>1,963,799</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1950-51</td>
<td>1,143,466</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1951-52</td>
<td>444,627</td>
<td>58.7</td>
<td>6.9</td>
</tr>
<tr>
<td>1952-53</td>
<td>340,158</td>
<td>57.8</td>
<td>4.6</td>
</tr>
<tr>
<td>1953-54</td>
<td>6,870,760</td>
<td>89.3</td>
<td>8.3</td>
</tr>
<tr>
<td>1954-55</td>
<td>-4,547,472</td>
<td>94.8</td>
<td>15.0</td>
</tr>
<tr>
<td>1955-56</td>
<td>875,985</td>
<td>107.5</td>
<td>13.0</td>
</tr>
<tr>
<td>1956-57</td>
<td>2,258,216</td>
<td>123.1</td>
<td>15.9</td>
</tr>
<tr>
<td>1957-58</td>
<td>15,478,413</td>
<td>149.0</td>
<td>21.9</td>
</tr>
<tr>
<td>1958-59</td>
<td>35,050,140</td>
<td>172.6</td>
<td>29.5</td>
</tr>
<tr>
<td>1959-60</td>
<td>63,707,000</td>
<td>229.3</td>
<td>53.9</td>
</tr>
<tr>
<td>1960-61</td>
<td>74,481,063</td>
<td>211.7</td>
<td>53.1</td>
</tr>
<tr>
<td>1961-62</td>
<td>94,719,930</td>
<td>291.5</td>
<td>63.9</td>
</tr>
<tr>
<td>1962-63</td>
<td>85,006,580</td>
<td>360.0</td>
<td>81.4</td>
</tr>
<tr>
<td>1963-64</td>
<td>51,433,663</td>
<td>407.0</td>
<td>116.7</td>
</tr>
<tr>
<td>Total (1951-52-1963-64)</td>
<td>426,119,053</td>
<td>2,352.3</td>
<td>484.1</td>
</tr>
</tbody>
</table>

b/ Fertiliser Statistics, 1982-83, Fertiliser Association of India, New Delhi, pp. 178-79.
The policy of pooling supplies and regulating their distribution initiated a trend of growth in fertilizer consumption in the non-plantation sector on a fairly wide geographic range.\textsuperscript{13} For a country of India's size and diversity, this achievement was significant, especially given the persistent constraints on increasing total fertilizer supply and the absence of subsidies. Credit goes to the following features of the policy: assignment of a substantial proportion of total supplies to the non-plantation sector; the involvement of state governments in procuring fertilizer supplies and linking the supplies with the agricultural production program; creation of a fertilizer delivery system that, for all its deficiencies, was still quite widespread and was linked to the agricultural credit system; and uniform prices for fertilizers all over the country.

The experience of policy-makers and administrators with this policy made them aware that overcoming supply constraints and deficiencies in the distribution system was more important in raising fertilizer use than were high fertilizer prices. This conclusion was evident in the \textit{Report of the Fertiliser Distribution Enquiry Committee} (1960).

\begin{tabular}{|c|c|c|c|}
\hline
\hline
Up to 1 & 56.6 & 16.3 & 0.7 \\
1.1 to 2 & 24.3 & 12.7 & 3.5 \\
2.1 to 5 & 11.4 & 17.3 & 8.5 \\
5.1 to 10 & 5.8 & 18.4 & 12.4 \\
10.1 to 30 & 1.9 & 30.7 & 28.0 \\
30.1 to 50 & - & 3.2 & 19.9 \\
50.1 to 100 & - & 1.4 & 21.0 \\
Above 100 & - & - & 6.0 \\
\hline
Total & 100.0 & 100.0 & 100.0 \\
\hline
\end{tabular}

Source: \textit{Fertiliser Statistics}, Fertiliser Association of India, New Delhi.

\textsuperscript{13} This trend is evident in the following figures, which show per hectare consumption of fertilizers in India in the early 1960s and early 1980s. It also covers 1967/68-1968/69, when high-yield varieties were introduced.
Table 4: RATIOS OF NITROGEN TO PADDY AND WHEAT PRICES IN DIFFERENT STATES, 1956-57 to 1964-65

<table>
<thead>
<tr>
<th>State</th>
<th>Ratio of N to paddy prices&lt;sup&gt;a/&lt;/sup&gt;</th>
<th>Ratio of N to wheat prices&lt;sup&gt;a/&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Bihar</td>
<td>5.7</td>
<td>4.3</td>
</tr>
<tr>
<td>West Bengal</td>
<td>5.3</td>
<td>3.5</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>6.8</td>
<td>5.9</td>
</tr>
<tr>
<td>Punjab</td>
<td>6.2</td>
<td>4.2</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>5.0</td>
<td>3.4</td>
</tr>
<tr>
<td>Gujarat</td>
<td>4.2</td>
<td>3.3</td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>7.2</td>
<td>5.2</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>4.9</td>
<td>3.0</td>
</tr>
<tr>
<td>Karnataka</td>
<td>5.3</td>
<td>3.5</td>
</tr>
<tr>
<td>Andhra Pradesh</td>
<td>5.1</td>
<td>3.6</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>5.8</td>
<td>3.5</td>
</tr>
<tr>
<td>Kerala</td>
<td>5.3</td>
<td>3.5</td>
</tr>
</tbody>
</table>

<sup>a/</sup> The average price of nitrogen in different states calculated from the prices of different fertilizers weighted according to their relative importance. Prices of paddy and wheat are based on farm harvest prices.

<sup>b/</sup> Average of 9 years from 1956-57 to 1964-65.

Source: Fertiliser Statistics, Fertiliser Association of India, New Delhi.

That awareness was also decisive in the Government's decision to set up a Committee on Fertilisers in the final years of the Third Five Year Plan (1960-61 to 1965-66) and in the formulation of proposals for the Fourth Five Year Plan. When these proposals were being developed, the Government realized that any breakthrough in agricultural production would have to be based on a massive increase in fertilizer consumption, since 44 percent of the additional foodgrain production in the Fourth Plan was dependent on increased use of fertilizers (India, 1965). Against this background, the committee was to examine the short- and long-term problems in rapidly raising fertilizer consumption.

Most of the committee's major recommendations were incorporated in the comprehensive fertilizer policy the Government announced in December 1965 as a part of the New Agricultural Strategy. Hence the committee's diagnosis of the problems and policy prescriptions are important in
understanding the evolution of fertilizer policy in India. While it is beyond the scope of this paper to cover all points, the following deserve attention.

The Committee on Fertilizers underscored the urgent need to accelerate growth in fertilizer consumption—from less than 1 million tons in 1965–66 to 4.1 million tons in 1970–71 and to 7.2 million tons in 1975–76. (As Table 1 shows, fertilizer consumption exceeded 4 million tons in 1977–78 and 7 million tons in 1983–84.) The committee believed that growth in fertilizer consumption of that magnitude was feasible not only because fertilizer-responsive high-yield varieties had been introduced after the mid-1960s, but also because of the potential profitability of fertilizer use on non-high-yield varieties with and without irrigation. For these reasons, the committee saw no need to subsidize fertilizers to achieve the desired rate of growth in consumption. However, it did see a need for price supports for agricultural commodities, and it also recommended that fertilizer prices to farmers not exceed Rs. 1,850, Rs. 1,750 and Rs. 625 a ton of N, P2O5 and K2O, respectively, during the Fourth Plan period.

The committee identified important constraints on achieving the desired growth in consumption in five major spheres: (1) aggregate availability of fertilizers; (2) arrangements for procuring and delivering fertilizers; (3) the fertilizer distribution system; (4) availability of adequate credits for distributors as well as for farmers; and (5) fertilizer promotion. It made a number of recommendations, of which key ones relating to enlarging supplies and developing the distribution system are especially relevant.

To increase the availability of fertilizers, the committee opted for domestic production over imports. 14/ It recommended a substantial expansion in the domestic production capacity for nitrogen—from less than 0.5 million tons in 1965–66 to 3.4 million tons in 1970–71 and 5.0 million tons in 1975–76. To meet the shortfall in availability until 1970–71, it recommended imports of 6.5 million tons of nutrients during the period of

14/ The report does not say why. It appears that the committee was influenced by the foreign exchange constraints of importing growing quantities of fertilizers, by economies of scale in the fertilizer industry and by the potential size of the domestic market. It could also have been influenced by considerations of self-sufficiency in the supply of so critical an input and by the interest multinationals were showing in investing in India's fertilizer industry. Further, growth of the fertilizer industry was consistent with the orientation in India's growth strategy toward basic and heavy industries and a growing realization that a breakthrough in food production was critical.
the Fourth Plan and an allocation of foreign exchange of Rs. 7,765 million for imports of fertilizers, rock phosphate and sulphur. 15/

To fix the prices of nitrogenous fertilizers, the committee recommended the continuation of the practice of pooled prices because of the disparities between indigenous and import prices and because of the variation in the cost of production among domestic factories. 16/ For the same reasons and because of zonal imbalances in production and consumption, it recommended that the distribution arrangements be continued through the Central Fertilizer Pool in the short run. However, the proportion of domestic fertilizers acquired by the Pool was to be gradually decreased, and the pooling arrangements were to be terminated when domestic production of nitrogen reached 1.2 million tons, so as to give domestic manufacturers freedom in marketing their products. The committee also recommended eliminating the monopoly of the cooperatives in the fertilizer distribution system, increasing the number of retail outlets and raising the distribution margins. Similarly, it called for concessional freight rates from ports to inland factories on imported rock phosphate and sulphur, and the elimination of customs and excise duties on imported fertilizers, fertilizer raw materials and fertilizer machinery to bring down the prices of fertilizers. 17/

The Government implemented some of the major recommendations of the committee soon after 1965. For instance, the amount of domestic nitrogenous fertilizers acquired by the Central Fertilizer Pool was gradually reduced beginning in 1967-68, and in 1969-70 the pooling was terminated, leaving manufacturers free to market their own products. Producers of complex fertilizers were also allowed to fix their prices. (However, the prices of ammonium sulphate, calcium ammonium nitrate and

15/ The following quotation reveals the importance attached to the allocation of foreign exchange for fertilizer imports: "The Committee recommends that the required foreign exchange should be assurance for fertiliser imports as fertiliser inputs are practically the sheet-anchor of the entire plan for agriculture. In the context of general scarcity of fertiliser availability in the world markets, long term contracts with suppliers can assure adequate and timely supplies over a period of time...The assurance of the foreign exchange requirements for fertiliser imports for the period of the Fourth Plan on the basis of high priority for fertiliser use is also necessary for such long-term arrangements to be conducted." (Emphasis added) (India, 1965, pp. 21-22)

16/ The same considerations led the Fertiliser Prices Committee to the Fertiliser Retention Prices Scheme in 1977.

17/ These recommendations, made in 1965, are similar to the arguments of the fertilizer industry in recent years on lowering the cost of production of fertilizers in India. See the speeches of the chairman of the Fertilizer Association of India, reported in various issues of Fertiliser News in the last five years or so. For a very forceful and persuasive plea on this score, see Venkitramanan (1983).
urea remained statutorily fixed under the Fertiliser Control Order.) The monopoly of the cooperatives in fertilizer distribution was abolished, while the distribution margins were revised upwards. As for increasing the supplies, the Government imported 5.1 million tons of nutrients between 1966-67 and 1970-71. While this was nearly 80 percent of the committee's recommendation, it must be seen against the dismal growth in domestic production. By 1970, domestic capacity for nitrogen production had risen to only 1.3 million tons, as compared with the committee's recommendation of 3.4 million tons, a level reached only in 1979-80. And the actual production of nitrogen plus P2O5 from 1966-67 to 1970-71 was only half what the committee had assumed when working out the import requirements. The near stagnation in the growth of fertilizer consumption in the early 1970s (Table 1) was caused mainly by the tight availability of fertilizers. In turn, the shortage was the result of the impact that a continuous decline in fertilizer imports from 1967-68 to 1970-71 had on carryover stocks, combined with the poor growth in domestic production. 18/

With respect to fertilizer prices and pricing policy, the post-1965 period can be divided into two sub-periods, consisting of the years up to and after 1973-74.

Between 1966-67 and 1973-74, the farmgate prices of all fertilizers taken together increased by about 60 percent. Most of this increase came in 1967-68 and 1973-74 (Table 5). In 1967-68, fertilizer prices rose because of a 57 percent devaluation of the rupee in June 1966. In 1973-74, the rise was attributable to the increased costs of fertilizer imports. Given the magnitude of the devaluation and the importance of imports to the availability of fertilizers, the 1967-58 increase in retail prices was relatively small. Details about the loss incurred by the Central Fertilizer Pool because of this policy are not readily available. It is unlikely to have been substantial, however, once the initial impact of the devaluation had passed. This conclusion is suggested by the trends in the unit cost of imported fertilizers shown in Table 6. It is also suggested by the information in Report of the Committee on Controls and Subsidies (1979). This report shows, under "Imports of nitrogenous fertilizers," a surplus of Rs. 200 million in 1971-72 and Rs. 180 million in 1972-73, and a deficit of Rs. 330 million in 1973-74. (No data are available for the years before 1971-72). The relevant tables in the report do not show any subsidy for domestic fertilizers during the above three years.

18/ For evidence on how inadequate supplies restricted growth in fertilizer consumption during the early 1970s, see Desai (1978 and 1982). For micro-level evidence, see various papers on "Agricultural Input Supply Systems Including Marketing" and "Impact of Increase in Input Prices on Profitability and Production" (1976).
Table 5: INDEX NUMBERS OF RETAIL PRICES\(^a\)/ OF MAJOR FERTILIZERS IN INDIA, 1966-67 to 1983-84

<table>
<thead>
<tr>
<th>Year</th>
<th>Urea</th>
<th>AS</th>
<th>SSP</th>
<th>DAP</th>
<th>MOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1966-67</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1967-68</td>
<td>124</td>
<td>121</td>
<td>126</td>
<td>132</td>
<td>128</td>
</tr>
<tr>
<td>1968-69</td>
<td>126</td>
<td>123</td>
<td>126</td>
<td>132</td>
<td>141</td>
</tr>
<tr>
<td>1969-70</td>
<td>139</td>
<td>131</td>
<td>120</td>
<td>147</td>
<td>151</td>
</tr>
<tr>
<td>1970-71</td>
<td>139</td>
<td>130</td>
<td>123</td>
<td>147</td>
<td>151</td>
</tr>
<tr>
<td>1971-72</td>
<td>136</td>
<td>134</td>
<td>122</td>
<td>163</td>
<td>151</td>
</tr>
<tr>
<td>1972-73</td>
<td>141</td>
<td>134</td>
<td>123</td>
<td>169</td>
<td>157</td>
</tr>
<tr>
<td>1973-74</td>
<td>154</td>
<td>147</td>
<td>178</td>
<td>169</td>
<td>194</td>
</tr>
<tr>
<td>June 1974</td>
<td>294</td>
<td>228</td>
<td>255</td>
<td>362</td>
<td>353</td>
</tr>
<tr>
<td>July 1975</td>
<td>272</td>
<td>228</td>
<td>305</td>
<td>338</td>
<td>338</td>
</tr>
<tr>
<td>Dec. 1975</td>
<td>272</td>
<td>228</td>
<td>282</td>
<td>313</td>
<td>313</td>
</tr>
<tr>
<td>Mar. 1976</td>
<td>257</td>
<td>228</td>
<td>199</td>
<td>266</td>
<td>260</td>
</tr>
<tr>
<td>Feb. 1977</td>
<td>243</td>
<td>228</td>
<td>137</td>
<td>266</td>
<td>230</td>
</tr>
<tr>
<td>Oct. 1977</td>
<td>228</td>
<td>228</td>
<td>137</td>
<td>266</td>
<td>230</td>
</tr>
<tr>
<td>Mar. 1979</td>
<td>213</td>
<td>220</td>
<td>153</td>
<td>266</td>
<td>230</td>
</tr>
<tr>
<td>June 1980</td>
<td>294</td>
<td>383-408</td>
<td>249</td>
<td>369</td>
<td>315</td>
</tr>
<tr>
<td>July 1981</td>
<td>346</td>
<td>383-408</td>
<td>270</td>
<td>436</td>
<td>373</td>
</tr>
<tr>
<td>June 1983</td>
<td>316</td>
<td>383-408</td>
<td>350</td>
<td>404</td>
<td>347</td>
</tr>
</tbody>
</table>

\(a/\) Exclusive of sales tax and local duties but inclusive of the excise duty.

Source: Calculated from data on fertilizer prices in Fertiliser Statistics, Fertiliser Association of India, New Delhi, various Issues.

After 1973-74, the story is different with respect to both changes in fertilizer prices and fertilizer price policy. As shown in Table 5, the retail prices for all fertilizers went up substantially in 1974-75, irrespective of whether they were statutorily controlled by the government. The price rise was greater than the increased cost of domestic production, but considerably less than the increased cost of imported fertilizers (Tables 4 and 5). To prevent any adventitious gain to domestic producers and to reduce the burden of the subsidy on imported fertilizers, the Government introduced a Fertiliser Prices Equalisation Charge. It ran as high as Rs. 610 a ton of urea.

The sudden large increases in fertilizer prices in 1974-75 coincided with a nearly 10 percent decline in total fertilizer off-take. Although the disaggregated and micro-level evidence is mixed,\(^{19/}\) it can

\(^{19/}\) For disaggregated evidence, see the time series on fertilizer consumption at the state and district levels. See also Desai (1978) and Sah, who also reveals mixed evidence. For micro-level evidence, see various papers on the "Impact of Increase in Input Prices on Profitability and Production" (1976) and the Rapporteur's Report on the subject (1976).
reasonably be said that the rise in fertilizer prices had an adverse impact on total consumption. This is, however, the only instance in more than three decades in which the magnitude of the year-to-year change in aggregate fertilizer consumption can be attributed with no hesitation to a change in fertilizer prices (in either nominal or real terms).

Concerned over the sizable decline in consumption, the Government reduced the prices for fertilizers in 1975, 1976, 1977 and 1979 (Table 5), even though an upward trend in fertilizer consumption resumed at an impressive pace in 1975-76 (Table 1). The reductions in prices were facilitated by a decline in the unit cost of imported fertilizers (Table 6) and by a lowering of the Fertiliser Prices Equalisation Charge levied on the domestic fertilizer industry from 1974 on. On the other hand, the reductions led, for the first time, to a substantial and rising burden of fertilizer subsidies.

Table 6: UNIT COST OF MAJOR IMPORTED FERTILIZERS, 1967-68 to 1981-82

<table>
<thead>
<tr>
<th>Fiscal year (April 1 to March 31)</th>
<th>Urea</th>
<th>CAN</th>
<th>AS</th>
<th>DAP</th>
<th>MOP</th>
<th>Value of total imports (Rs. million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1967-68</td>
<td>652</td>
<td>398</td>
<td>445</td>
<td>622</td>
<td>391</td>
<td>1,933</td>
</tr>
<tr>
<td>1968-69</td>
<td>684</td>
<td>421</td>
<td>351</td>
<td>778</td>
<td>387</td>
<td>1,630</td>
</tr>
<tr>
<td>1969-70</td>
<td>662</td>
<td>428</td>
<td>332</td>
<td>521</td>
<td>345</td>
<td>1,168</td>
</tr>
<tr>
<td>1970-71</td>
<td>588</td>
<td>389</td>
<td>330</td>
<td>592</td>
<td>387</td>
<td>768</td>
</tr>
<tr>
<td>1971-72</td>
<td>454</td>
<td>358</td>
<td>167</td>
<td>567</td>
<td>305</td>
<td>900</td>
</tr>
<tr>
<td>1972-73</td>
<td>504</td>
<td>384</td>
<td>215</td>
<td>787</td>
<td>318</td>
<td>1,213</td>
</tr>
<tr>
<td>1973-74</td>
<td>713</td>
<td>792</td>
<td>514</td>
<td>1,058</td>
<td>453</td>
<td>1,768</td>
</tr>
<tr>
<td>1974-75</td>
<td>2,180</td>
<td>1,556</td>
<td>1,112</td>
<td>2,253</td>
<td>730</td>
<td>5,991</td>
</tr>
<tr>
<td>1975-76</td>
<td>2,375</td>
<td>1,557</td>
<td>1,497</td>
<td>2,757</td>
<td>839</td>
<td>7,228</td>
</tr>
<tr>
<td>1976-77</td>
<td>1,110</td>
<td>1,089</td>
<td>1/a</td>
<td>1,442</td>
<td>693</td>
<td>2,202</td>
</tr>
<tr>
<td>1977-78</td>
<td>1,231</td>
<td>867</td>
<td>737</td>
<td>1,495</td>
<td>707</td>
<td>3,064</td>
</tr>
<tr>
<td>1978-79</td>
<td>1,284</td>
<td>887</td>
<td>763</td>
<td>1,355</td>
<td>707</td>
<td>4,600</td>
</tr>
<tr>
<td>1979-80</td>
<td>1,497</td>
<td>1,060</td>
<td>733</td>
<td>1,729</td>
<td>860</td>
<td>5,545</td>
</tr>
<tr>
<td>1980-81</td>
<td>1,896</td>
<td>1,246</td>
<td>760</td>
<td>2,185</td>
<td>1,192</td>
<td>9,252</td>
</tr>
<tr>
<td>1981-82</td>
<td>2,085</td>
<td>1/a</td>
<td>767</td>
<td>2,206</td>
<td>1,246</td>
<td>7,166</td>
</tr>
</tbody>
</table>

/a/ Not imported.

Source: Calculated from data in Fertiliser Statistics, 1982-83, Fertiliser Association of India, New Delhi, pp. 1-56 and 57.
As shown in Table 2, both imported and domestic fertilizers were subsidized after 1975-76. The relative burden of the subsidies on domestic fertilizers has been higher than on imported fertilizers in every year after 1977-78 except 1980-81, when the retail prices of fertilizers were raised substantially, as shown in Table 5. Despite the increases in the retail prices, the total amount of the subsidy paid on domestic fertilizers did not go down in 1981-82 (Table 2). Even more significant, the share of domestic fertilizers in the total subsidy grew rapidly after 1980-81, reaching as high as 86 percent in 1983-84. Part of the explanation lies in the rising relative importance of domestic fertilizers in total consumption. However, the increased domestic supply was possible because of new fertilizer plants, which in general had higher unit costs of production. Thus, the question of the relative importance of domestic and imported fertilizers in the total fertilizer subsidy is tied up with the fertilizer pricing policy. This point is stressed because the relative importance of domestic production and imports in total fertilizer supply is decided not by competitive market forces but by the macro policy of the Government about sources of fertilizer supply.

The total subsidy for domestic fertilizers has three components: (1) payments to manufacturers of nitrogenous and phosphatic fertilizers under the Fertiliser Retention Prices Scheme; (2) payments of subsidies to manufacturers of single super phosphate; and (3) payments under the Fertiliser Freight Subsidy Scheme for delivery up to block headquarters. In 1983-84, the shares of these components in the total subsidy of Rs. 9,000 million on domestic fertilizers were 77.6, 2.8 and 20.6 percent respectively. Thus, the payments under the Fertiliser Retention Prices Scheme were the dominant component. The subsidy under this scheme grew from Rs. 250 million in 1977-78 to Rs. 6,900 million in 1983-84. (The budget estimate for 1984-85 is Rs. 7,150 million.)

The Fertiliser Retention Prices Scheme was introduced in November 1977 on the recommendation of the Fertiliser Prices Committee set up by the Ministry of Chemicals and Fertilisers in 1976. The committee, under the chairmanship of S. S. Marathe, chairman of the Bureau of Industrial Costs and Prices, was to examine the existing basis of fertilizer pricing and recommend a pricing policy that would ensure a fair, sustained return on investment.

The need to set up the above committee arose for several reasons. On the recommendation of the Committee on Fertilisers, the government had stopped procuring fertilizers at a "fair retention price" from domestic factories beginning in 1969-70, leaving them "free" to market their own products. However, the Government continued to control the retail prices of fertilizers either statutorily or informally. This policy adversely affected the return on investment in the domestic fertilizer industry, especially of new plants. The impact of the oil crisis on the cost of fertilizer raw materials worsened the situation. By the mid-1970s, the average cost of production exceeded the average ex-factory realization price for a majority of the domestic producers, although the impact differed by plant based on such factors as age, location, size, technology, feedstock, capital investment and pattern of financing. The price policy was critical to the fertilizer plants under construction and to new
investment in additional capacity, given the steep escalation in capital costs and feedstock prices after 1973.

On the basis of many studies on technical, economic and cost aspects and much deliberation and weighing of different alternatives, the Fertiliser Prices Committee recommended that ex-factory retention prices be fixed for each plant. The individual ex-factory retention price was to be calculated so as to assure a 12 percent post-tax return on net worth if the factory utilized 80 percent of its installed capacity and achieved certain norms with respect to the consumption of raw materials, utilities and other inputs. This policy was an astute way of combining incentives for and efficiency in the fertilizer industry.

The committee submitted its report on a pricing policy for urea, ammonium sulphate and calcium ammonium nitrate in July 1977. The Government accepted the committee's recommendations and introduced the Fertiliser Retention Prices Scheme for the above fertilizers in November 1977. It was extended to complex fertilizers in February 1979 and to single super phosphates in May 1982.

Under the scheme, retention prices are fixed for each plant for three years, after which they are revised. The scheme is administered by the Fertiliser Industry Coordination Committee (FICC), an office attached to the Ministry of Chemicals and Fertilisers. The FICC also administers the Fertiliser Price Fund Account to which the differences between the maximum ex-factory price and the individual ex-factory retention prices are credited/debited.

The Fertiliser Retention Prices Scheme was an important landmark in India's fertilizer pricing policy. Until then, statutory price controls were levied on fertilizers only at the retail (i.e., consumers') level. The retention price scheme extended it to producers. However, most important is that the scheme aimed at assuring a 12 percent post-tax return on net worth, providing the manufacturers achieved specified norms with respect to capacity utilization, etc. Thus, for the first time, the fertilizer price policy showed a concern for farmers, fertilizer manufacturers and efficiency in the industry.

It is difficult to fault the principles of this policy, especially because administered price regimes for fertilizers became the rule rather than the exception following the oil crisis of the 1970s, at least in the developing world. Payments made to the domestic fertilizer industry under the scheme, which were the dominant component of the fertilizer subsidies, should thus be seen as the cost of adopting a fertilizer price policy that is concerned about the interests of both fertilizer consumers and producers, as well as about healthy growth in the industry.

Nevertheless, the fertilizer subsidy has been a burden on budgetary resources. This cost is an inevitable part of a policy that meets growing proportions of fertilizer requirements through greater domestic production and yet keeps the fertilizer prices to farmers at
levels that do not reflect the cost of production. Whether the policy of
supplying fertilizers by greater domestic production is right cannot be
answered here. The issue is complex, involving India's large and growing
requirements, \textsuperscript{20} the technological capability and experience gained in
fertilizer production technology, the vast potential to use this
experience, and the place of the fertilizer industry in the overall
strategy of economic development (see various papers in Fertiliser
Association of India, 1980.)

Given that the Government has chosen to meet the growing
requirements for fertilizers through further expansion of the domestic
industry, it has two options. One is to live with the growing burden of
fertilizer subsidies. The second is to reduce that burden by lowering the
costs of fertilizer production and raising the retail prices of
fertilizers.

There is ample scope to reduce costs in the fertilizer industry,
but the task may not be easy. Three aspects should be distinguished. The
first relates to the prices of raw materials and of services charged to the
fertilizer industry, and the taxes and duties on raw materials and
equipment. These pricing and fiscal policies need to be examined, not only
in terms of lowering the prices of and tax burden on the fertilizer
industry, but also to understand the magnitude of the "real" burden of
fertilizer subsidies (see various articles in \textit{Fertiliser News} (May 1983),
especially Venkitramanan). The second aspect relates to improving the
performance and efficiency of fertilizer plants. While some units are
performing as well as the best plants anywhere, overall the performance of
the industry has considerable scope for improvement. What is required is
to identify the critical bottlenecks plant by plant, and to remedy the
chronic deficiencies in the infrastructure such as power and water supplies
and transport. \textsuperscript{21} The third aspect relates to better planning, speedier
implementation and sound economic analysis in taking up new fertilizer
projects. Even if concerted efforts are made in all three directions, the
average real cost of all the fertilizers supplied by the domestic industry
may rise over time because of the higher investment costs of new plants,
from which growing proportions of the domestic supply will be coming.

Viewed thus, there is a clear need for a judicious policy of
fixing the fertilizer prices to be paid by farmers. Two things are
necessary. First, proper coordination between pricing policies for
fertilizers and crops needs to be established. Second, correct
appreciation of the role of the fertilizer price environment in the growth
of fertilizer use must be developed.

\textsuperscript{20} Even at present India ranks either first or second (after China) in
net imports of fertilizers among countries, both developing and
developed.

\textsuperscript{21} See Jain and Nand (1980). See also various issues of \textit{Fertiliser News}
in the last three years, where this topic has been discussed and
analyzed again and again.
The need for a coordinated approach in pricing policies for fertilizers and crops is obvious, since the profitability of a farmer's use of fertilizers depends on both. 

In this context, it is important to note that while the nominal prices of fertilizers in the early 1980s were substantially higher than in the late 1960s, in real terms they were about the same. Table 7 shows the maximum retail prices of three fertilizers and the procurement (or minimum support) prices of important crops from 1967-68 to 1983-84. In drawing conclusions about the real prices of fertilizers from the table, note that the farm harvest prices of crops have often been higher than the procurement or minimum support prices. Even more important, the real prices of fertilizers have consistently improved over time as far as crops like pulses, groundnut and other oilseeds are concerned. Yet all the evidence indicates that despite the potential profitability of fertilizer use on these crops, most of the area under these crops is not fertilized (for evidence on the growth in fertilizer consumption by crop, see Desai, 1982). This and other evidence for many crops and regional locations show that the fertilizer price environment (in either nominal or real terms) is only one of the factors affecting the growth of fertilizer use. This point is well worth remembering when discussing fertilizer price policy for further sustained growth in consumption. This is especially so because of the complexities of and compulsions in fertilizer pricing policy discussed above, and the importance of certain non-price factors and policy instruments, as shown in the next section.

III. NON-PRICE POLICIES AND GROWTH IN CONSUMPTION

Three simple propositions form a good starting point for discussing the policies required to sustain rapid growth in fertilizer consumption. First, the economic potential of fertilizer use is determined by fertilizer response functions, the cost of fertilizers and the prices of crops. Second, actual fertilizer use is an outcome of the conversion of economic potential into farmers' demand for fertilizers, a demand being met through fertilizer supply and distribution systems at numerous micro-locations. Third, the evidence clearly suggests that the present level of fertilizer consumption is well below potential, as determined by the fertilizer response function-cum-price environment.

It follows from these propositions that the rate of growth in consumption will depend on converting untapped potential into actual fertilizer consumption and on continuously raising the potential for fertilizer use. Accordingly, there are two central questions. First, what

22/ The need is especially important at this stage because of the substantial burden of food and fertilizer subsidies on the budget. In 1983/84, even though the procurement prices of crops were raised, fertilizer prices were lowered by about 7 percent, adding nearly Rs. 2,000 million to an already heavy burden of fertilizer subsidies.

23/ For elaboration of the arguments presented in this section, see Desai (1983a).
Table 7: Maximum Retail Prices of Fertilizers (Excluding of Sales and Local Taxes) and Procurement (or Minimum Support) Prices of Important Agricultural Crops, 1967/68-1983/84
(Rs. per 100 kg.)

<table>
<thead>
<tr>
<th>Year</th>
<th>NA/y</th>
<th>P2O5/b</th>
<th>K2O/c</th>
<th>Paddy</th>
<th>Wheat Grains</th>
<th>Coarse Groundnut</th>
<th>Sugarcaned</th>
<th>Seed Cotton</th>
<th>Jute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1967/68</td>
<td>183</td>
<td>184-195</td>
<td>73</td>
<td>45-56</td>
<td>65-95</td>
<td>43-55</td>
<td>7.37</td>
<td>f/</td>
<td>f/</td>
</tr>
<tr>
<td>1970/71</td>
<td>205</td>
<td>175-199</td>
<td>87</td>
<td>46-58</td>
<td>76</td>
<td>55</td>
<td>7.37</td>
<td>299</td>
<td>107.17</td>
</tr>
<tr>
<td>1971/72</td>
<td>201</td>
<td>289-353</td>
<td>89</td>
<td>47-58</td>
<td>76</td>
<td>55</td>
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<td>134</td>
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<td>160</td>
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<td>217</td>
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<td>130</td>
<td>116</td>
<td>270</td>
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<td>f/</td>
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<tr>
<td>1982/83</td>
<td>531</td>
<td>587</td>
<td>217</td>
<td>122</td>
<td>142</td>
<td>118</td>
<td>295</td>
<td>13.00</td>
<td>380</td>
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<tr>
<td>1983/84</td>
<td>467</td>
<td>531</td>
<td>200</td>
<td>132g/</td>
<td>151</td>
<td>124</td>
<td>235</td>
<td>315</td>
<td>13.50</td>
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</table>

a/ Based on urea.
b/ Based on single super phosphate.
c/ Based on muriate of potash.
d/ Statutory minimum price.
e/ MP Virnar variety up to 1970/71, 320P/J-34P variety up to 1982/83, F-414/11 777 variety in 1983/84. For Hybrid 5 variety in 1983/84, Rs. 527.
f/ Not announced.
g/ Common variety; Rs. 136 for fine and Rs. 140 for superfine varieties.

efforts are required to convert the untapped potential into fertilizer use? Second, what changes must be made in the agro-economic variables to increase continuously the potential for fertilizer use?

Generating growth in fertilizer consumption through tapping unexploited potential depends on (1) extension of the use of fertilizers to land that is not being fertilized, even though it is potentially profitable from the farmers' point of view, and (2) raising the rates of application from sub-optimal to optimal on already fertilized land.

Most of the scope for a further extension of fertilizer use involves unirrigated areas all over the country in different agro-climatic environments. To speed up the spread of fertilizers to these areas, knowledge on fertilizer response functions specific to the area, and details on fertilizer practices and other agronomic matters, need to be generated and disseminated to farmers. These efforts should be supplemented simultaneously by an adequate and timely flow of credit to farmers and by development of an efficient fertilizer distribution system. In other words, the processes that convert potential into effective demand for fertilizers and that make fertilizers available must be strengthened. Price incentives alone are not adequate. For sustained growth in fertilizer demand, there must be a widespread conviction among farmers that significant additional production will result from fertilizer use. In addition, they must know how to use fertilizers most advantageously under rainfed conditions. Similarly, if vigorous efforts to promote fertilizer use are absent and fertilizer turnover remains low, small increases in the distribution margins will not accelerate the geographic expansion of the distribution system to rainfed areas. Hence, strengthening agricultural research and extension activities must be emphasized.

Efforts to generate growth in fertilizer use in unirrigated areas will not be sustainable unless growth in the total supply of fertilizers stays ahead of growth in the market for fertilizers in irrigated areas.

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24/ The problem of raising fertilizer consumption when irrigation is limited or non-existent does not occur only with low rainfall. A study on the fertilizer growth performance of districts in the 1960s clearly showed that areas with low irrigation located in high rainfall regions, particularly in eastern India (including parts of Madhya Pradesh), performed the worst among all districts with little irrigation. See Desai and Singh (1973, chapter 4). The trends in the 1970s show a similar pattern. See also Desai (1983b).

25/ The need for this knowledge cannot be overemphasized. The amount of additional production resulting from fertilizers depends on such things as the timing and method of fertilizer application, balance among nutrients, sowing time, choice of variety and plant population. What makes these considerations critical in rainfed areas is that without appropriate agronomic practices, returns on fertilizer use are considerably lower than in irrigated areas. On the other hand, the research indicates that returns on fertilizer use in rainfed areas can be considerably enhanced by proper practices.
(i.e., present and newly irrigated areas). For some time to come, adequate supplies will depend on fertilizer imports. The policy for imports should be based on an understanding of the role the supply side plays in realizing the potential for increased fertilizer use under rainfed conditions. To accomplish this, improvements in the fertilizer promotion and distribution systems in rainfed areas are required. Experience shows that these improvements cannot be brought about without generating pressure from the fertilizer supply side on promotion and distribution systems serving rainfed regions. It is this understanding rather than short-term considerations of clearing inventories and saving foreign exchange, or a long-term policy of self-sufficiency in domestic production, that should govern policies regarding fertilizer imports.

Raising the rates of application on already fertilized land from sub-optimal to optimal is another way of generating growth in fertilizer consumption by tapping unexploited potential. Efforts here should focus on educating farmers about fertilizer practices such as balance among nutrients, correct timing and placement of fertilizers, and use of micro-nutrients and soil amendments. Research indicates that changes in fertilizer practices resulting from these efforts will increase fertilizer use efficiency in crop production, an outcome that will benefit both farmers and society as a whole. Conversely, raising the rates of application through injudicious use of a pricing policy will only increase either the fertilizer subsidies or inflation or both.

To strengthen efforts in the above direction, location-specific research on optimal fertilizer practices and application of this knowledge by the agricultural extension system are essential. Similarly, the soil testing service needs to be strengthened. 26/

For sustained rapid growth in fertilizer consumption, tapping the unexploited potential through these efforts will not be enough. It is also important to raise the potential of fertilizer use. The urgency of this is indicated by the need to increase fertilizer consumption by more than 500,000 tons every year and the virtual exhaustion of the two main forces behind past growth in fertilizer consumption. These two forces were the diffusion of fertilizers on irrigated land and replacement of local crop varieties by fertilizer-responsive high-yield varieties on this land.

Theoretically, the potential for fertilizer use goes up as a result of upward shifts in response functions and/or a fall in the ratios of fertilizer to crop prices. Thus, two alternatives may raise potential fertilizer use. Shifting the response functions upwards is superior to either raising the prices of crops through unrealistic price support programs or lowering fertilizer prices by increasing the subsidies. This

26/ For information on the deficiencies in the soil-testing service and how their removal will increase the efficiency of fertilizer use, see Babaria (1977). See also Saikia (1982), Sevak (1982), and Sohal, et al.
approach is especially true for developing countries, because injudicious use of price policy instruments generates inflationary pressures and distracts attention from the tasks required to raise the productivity of fertilizer use, as experience in many countries shows.

To increase the potential for fertilizer use through continuous upward shifts in fertilizer response functions, it is necessary to accelerate the spread of irrigation and to strengthen the agricultural research and extension systems. There is considerable scope for enhanced efforts in both directions, and both farmers and society would benefit. As for a better price environment, that requires improving the fertilizer supply and distribution systems to lower the "real" cost of fertilizers to farmers by making them available at the right time and place. An objective evaluation of the Fertiliser Freight Subsidy Scheme, on which Rs. 1,850 million were spent in 1983-84, seems necessary.

Concerted efforts in the above directions would continuously raise the potential for fertilizer use. Converting that potential into sustained rapid growth in consumption in turn depends on simultaneous development and coordinated functioning of the fertilizer promotion, distribution and supply systems. This condition cannot be overemphasized, especially given the experience of the time lags in extending fertilizers even to irrigated areas and promoting optimal fertilizer practices.

Thus, efforts to convert untapped potential into actual fertilizer use and to increase that potential continuously must be addressed simultaneously. There should be no hesitancy about investing in massive efforts to spread fertilizer use in unirrigated areas and to raise the rates of application on fertilized lands through research on and extension of optimal fertilizer practices. Without such efforts, India's fertilizer consumption cannot grow by more than 500,000 tons every year, a claim that is easy to show. Assume that irrigated areas are increased every year by 2.5 to 3 million hectares, that is, by 50 to 75 percent more than the average annual increment in the 1970s. Assume, further, that areas remain unfertilized until they receive irrigation, at which point they are fertilized with 100 kg. a hectare without any time lag. Even under these heroic assumptions, fertilizer consumption goes up by only 250,000 to 300,000 tons a year. Thus, to raise fertilizer consumption by more than 500,000 tons year after year requires that untapped potential be converted into actual fertilizer use, and that potential use be raised continuously.

The case for rapidly spreading fertilizer use in unirrigated areas and for raising the rates of application on fertilized land can be made on other grounds. More than 70 percent of India's cultivated land is unirrigated; about half will remain so even after developing the entire irrigation potential. Over 80 percent of the production of jowar, bajra, small millets, pulses and oilseeds, plus two-thirds of cotton, come from unirrigated areas. Even in the case of wheat and rice, unirrigated areas account for 30 to 40 percent of total production. Therefore, raising the productivity of unirrigated areas is crucial to generating sustained
yield-based growth in total agricultural production. Soil fertility in these areas is as important a constraint as any other on raising their productivity. In fact, it can be argued that unless concerted efforts are made to raise soil fertility through rapid and judicious use of fertilizers, there will be little incentive for farmers to invest in dry land technologies.

There is little disagreement over the need to raise the rates of application on irrigated and unirrigated fertilized land. Here the emphasis is on accomplishing this through research on and extension of optimal fertilizer practices, rather than through manipulation of prices. Clearly, high rates of fertilizer use cannot be an end in itself. They must contribute the maximum possible to additional agricultural production. Only then can they be viable in the long run. Optimal fertilizer practices such as balance among nutrients, correct timing and placement, and the use of soil amendments and micro-nutrients increase the response of crops to fertilizer use and thus raise the rates of application.

Tapping the potential for fertilizer use and raising it continuously calls for public investment in different areas. Equally important, effective mechanisms are needed to resolve the conflicts between different segments of the fertilizer system, and between short-term expendiencies and long-term goals. These measures are neither costless nor easy. However, what other less costly and equally effective alternatives are there to raise India's fertilizer consumption by more than 500,000 tons, year after year?
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Chapter 8

FERTILIZER PRICING IN INDIA

Pratap Narayan, Former Executive Director¹/  
Fertiliser Industry Coordination Committee,  
Ministry of Chemicals and Fertilizers

I. THE NEED FOR PRICE CONTROL

In developing countries such as India, resources are limited, while the population is vast and poverty acute, with large numbers of people at or below the subsistence level. Food is clearly a dominant issue, particularly where a country must import substantial quantities of basic foodgrains in order to meet national demand. Where foodgrains are in short supply, prices tend to be high, posing a serious problem for the poorer members of society. Governments therefore must find ways to ensure adequate supplies of food at reasonable prices.

Developing countries often pursue a number of approaches for dealing with this issue: increasing domestic food production and fixing the consumer prices of foodgrains. Increasing agricultural production in turn often means raising the consumption of fertilizers. Thus the production and use of fertilizers have become major issues in India's development policy.

The Fertilizer Industry

At present, India produces a number of fertilizers domestically. This is a major shift from the early days of fertilizer use, when almost all nutrients were imported. At that time continuing severe constraints on foreign exchange led the Government to pursue a policy of self-sufficiency in domestic production. It was believed this goal could be met in part because of the availability of most domestic raw materials.

The particulars of the production of nitrogen and phosphate by sector during 1982-83 are given below in Table 1.

In addition, imported fertilizers are also handled at various ports by various handling agencies, including some of the manufacturers. The marketing of fertilizers is done by the manufacturers/pool handling agencies through private trade as well as institutional agencies, as explained later. Extension and promotional work is undertaken by the State Agriculture Departments, although the manufacturers also undertake promotional work, including demonstrations, adoption of villages, etc.

¹/ Currently Executive Director of the Fertiliser Association of India.
Table 1: FERTILIZER PRODUCTION, 1982-83<sup>a</sup> ('000 tons)

<table>
<thead>
<tr>
<th>Product</th>
<th>Private Sector</th>
<th>Public Sector</th>
<th>Cooperative Sector</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>1,397.3 (46)</td>
<td>1,379.8 (45)</td>
<td>280.0 (9)</td>
<td>3,507.9</td>
</tr>
<tr>
<td>Phosphate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complex</td>
<td>233.4 (31)</td>
<td>260.5 (34)</td>
<td>267.7 (35)</td>
<td>761.6</td>
</tr>
<tr>
<td>SSP</td>
<td>200.8 (95)</td>
<td>10.5 (5)</td>
<td>-</td>
<td>211.3</td>
</tr>
<tr>
<td>TSP</td>
<td>-</td>
<td>10.8 (100)</td>
<td>-</td>
<td>10.8</td>
</tr>
</tbody>
</table>

<sup>a</sup> Figures in parentheses indicate percentage of total.

Source: Fertiliser Statistics, Fertiliser Association of India, New Delhi.

In addition, imported fertilizers are also handled at various ports by various handling agencies, including some of the manufacturers. The marketing of fertilizers is done by the manufacturers/pool handling agencies through private trade as well as institutional agencies, as explained later. Extension and promotional work is undertaken by the State Agriculture Departments, although the manufacturers also undertake promotional work, including demonstrations, adoption of villages, etc.

Distribution and transportation have been difficult aspects of the industry. Two reasons are India's size and the location of the fertilizer plants, especially the older ones. Initially, plants tended to be located near the sources of raw materials (feedstock), generally the ports where imports arrived. Moreover, the refineries supplying some fertilizer feedstocks were found near the coast. These locations for fertilizer production were, however, particularly inappropriate in relation to the main centers of consumption—the three northern states of Punjab, Haryana and Uttar Pradesh, which together still account for 40 percent of the fertilizers used. More recently, the Government has been encouraging refineries to set up operations in the interior, and fertilizer plants are now locating nearer the areas of consumption. The possibility of gas being transported by pipeline has boosted this shift.

At present, distribution is handled by institutional agencies (networks of cooperatives, state-owned marketing federations and agro-industrial corporations) and by private trade agencies.
which account for about 50 percent of the fertilizer business, have two advantages from a national perspective. First, they go into the interior, unlike private distributors, who tend to concentrate in the marketing centers near the rail heads or in urban areas. Second, as the institutional agencies have no profit motive, they exercise a stabilizing influence on prices and counter possible exploitation of farmers by private traders. In fact, in the case of cooperative sector manufacturers like IFFCO, all the distribution is through the cooperative network.

The Government initially covered transport costs from the fertilizer plants to only the primary distribution points, or rail heads, normally located in large urban areas. As a result, the dealers concentrated in those areas, a pattern that forced farmers to travel long distances to get their supplies. To make fertilizers more easily available, in 1980 the Government began to cover the transport costs up to block headquarters, which are more local distribution points in specific marketing zones defined by the Government. As a result, more retail outlets have opened in the interior.

Where there has been a gap between demand and domestic production, the Ministry of Agriculture has controlled the distribution of fertilizers on the basis of a rational assessment of the demand in different states in every season and the likely supplies from different units and from imports. According to the Essential Commodities Act, in the two main cropping seasons—Rabi and Kharif—the Ministry of Agriculture allocates supplies in consultation with the State Governments and the manufacturers/pool handling agencies. This arrangement ensures that the requirements of any particular area are not ignored because manufacturers tend to go to areas of high consumption for ease of marketing.

Beyond the points already mentioned, the Government's marketing strategy for fertilizers is to dispatch from the manufacturing units/ports to the consumption centers, where the nutrients will be stored in godowns (storage units) and warehouses near the areas of consumption during the slack season so that they are readily available in the peak season. The Government also maintains buffer stocks at strategic points.

Need for Fertilizer Pricing

As mentioned, the Government sees a need to increase food production through greater use of fertilizers and to ensure that proper amounts of foodgrains are available to the poorer segments of society. These goals require fixing the price farmers pay for fertilizers at a level that encourages their use. That price will be determined in part by output (crop) prices, as the ratio of input prices, including fertilizers in particular, and output prices establishes the consumption of fertilizers, in turn a key determinant of the rate of growth in agriculture.
Thus, the government finds it desirable to fix prices to meet two broad objectives:

- Ensure that the weaker segments of society are not excluded from mass consumption goods such as foodgrains because of high prices.
- Encourage increased agricultural production to meet increasing demand by subsidizing inputs, such as fertilizers.

In India, the Government employs both approaches. It sets the prices consumers pay for foodgrains, but at the same time establishes minimum prices that farmers will receive for their crops.

The Government also fixes the prices for fertilizers at two levels: producer, or manufacturer, and consumer, or farmer in order to:

- Make fertilizers available to farmers at stable and reasonable prices to encourage increased agricultural production; and
- Give fertilizer producers a reasonable return on their investment to encourage efficiency and growth in the industry.

**Fertilizer and Foodgrain Pricing: An Overview**

As it has evolved, the fertilizer pricing system is structured as follows. By statute, the Government sets the prices farmers pay for fertilizers. To avoid regional distortions in consumption, a uniform price is fixed throughout the country, subject only to local taxes. The Government also fixes ex-factory retention prices for each manufacturer for each product. Allowance is made for a distribution margin, including reasonable transportation costs. The Government reimburses the manufacturers for the difference between net realization (the consumer price minus the distribution margin) on the one hand and the ex-factory retention price plus equated freight on the other. If, however, the net realization is greater than the retention price, the manufacturer pays the difference to the Fertiliser Price Fund Account.

Payments to manufacturers, which amount to a subsidy, are administered by the Fertiliser Industry Coordination Committee (FICC), which is chaired by the Secretary of the Ministry of Chemicals and Fertilizers and includes three other Ministry Secretaries, the Chairman of the Bureau of Industrial Costs and Prices, two chief executives from industry (one from the public sector, one from the private or cooperative sector) and the Executive Director, who serves as Member Secretary. The technical, cost and financial personnel are under the secretariat of the committee.
As to the foodgrain pricing policy, it also has two objectives:

- To make these products available to consumers at a reasonable cost; and
- To afford producers of foodgrains remunerative prices that encourage greater production.

Hence, the overall pricing policy has to be positive and oriented toward encouraging production, rather than being based on the more traditional free market approach in which prices may fluctuate to levels that discourage production. Moreover, maintaining high prices for agricultural commodities would benefit only a fraction of the farming community, as the majority of small farmers have no marketable surpluses and thus would not gain.

The main thrust of the agricultural pricing system is, therefore, to supply inputs at reasonable prices, on the one hand, and to provide farmers with a support price and to maintain a buffer stock, on the other. Under this policy, minimum support prices are guaranteed to farmers in the event of a glut in the market. The Government will purchase all quantities offered for sale at the support prices, which are fixed by the Agricultural Prices Commission. The Government also regularly sets procurement prices for the major foodgrains it buys for its public distribution system. These prices are higher than the support prices and are meant to provide greater incentives to farmers. The procurement prices have been raised from time to time.

In suggesting the minimum support prices for foodgrains, the Agricultural Prices Commission takes into consideration: the cost of production; changes in the prices of inputs; changes in the administered prices of competing crops; and the need to maintain overall stability in the economy. As to procurement prices, the commission considers: market prices; the prospects for production; expected prices in the coming year; and the needs of the public distribution system.

Even the free market price is controlled in that the Government releases supplies from the buffer stock in times of shortage. This system also obviates the need for heavy imports of foodgrains in times of shortage.

II. FERTILIZER PRICING

As noted, fertilizer prices are set at two levels: consumer and manufacturer. When designing a system to fix the consumer prices of fertilizers, the Government has two options:

- High input-high output prices, or
- Low input-low output prices.
In the former case, the price of fertilizers can be determined at a higher level consistent with the increasing costs of production. Correspondingly, the prices of foodgrains would also be fixed at a higher level. This approach has two pitfalls. First, it would preclude large numbers of small/marginal farmers from using reasonable amounts of fertilizers. Second, the resulting higher foodgrain prices would exclude consumption by the weaker sections of society.

The second option—low input–low output prices—is deemed preferable and consistent with the two broad objectives of fixing fertilizer prices. The Government keeps the consumer prices at a relatively lower level, a policy that is complemented by a system of subsidy to the manufacturers of indigenous fertilizers and handling agencies of imported fertilizers. In effect, this means a subsidy to the consumers of foodgrains as well, but one that is provided indirectly through the farmers and manufacturers/handling agencies.

The Government sets a uniform price throughout the country for both indigenous and imported fertilizers. The intent is to ensure that price distortions do not affect consumption in certain regions, nor bias farmers in favor of either indigenous or imported fertilizers, both of which situations would occur with differential pricing. The system also protects the consumers of fertilizers from fluctuations in the costs of domestic production or imports.

In accordance with this policy, the Ministry of Agriculture periodically sets maximum retail prices for nitrogenous fertilizers. The price of nitrogenous fertilizers, that is, urea, CAN and ammonium sulphate, had been under statutory price control since the mid-sixties. Complex phosphatic fertilizers were not placed under price controls at that time, and each manufacturer was free to fix its own prices. However, on March 16, 1976, phosphatic fertilizers were also subjected to price controls, albeit informal ones. The reason was that the oil crisis and consequent increase in the prices of the main inputs caused a major rise in the farmers' prices for phosphatic fertilizers, a rise that affected the growth in their consumption. The Government therefore introduced a flat subsidy of Rupees (Rs.) 1,250 a ton of P2O5, and consumer prices fell to that extent. Further, the manufacturers of phosphatic fertilizers agreed that any reductions in the prices of the main inputs would be passed on to farmers through consumer price reductions.

Insofar as single super phosphates were concerned, the consumer price was fixed by the Fertiliser Association of India in accordance with a formula agreed to with the Government, after taking into account the subsidy of Rs. 1,250 a ton of P2O5. This price differed from State to State (and also varied within a State), depending on the costs of production and transportation on the part of different manufacturers.

Beginning in February 1, 1979, complex fertilizers were also brought under statutory price control, as were single super phosphates on May 5, 1982. However, the control on ammonium sulphate and calcium ammonium nitrate was removed on June 8, 1980.
In fixing the consumer, or farmgate price, the Government seeks to maintain a reasonable ratio between the prices of inputs (fertilizers) and the prices of outputs (foodgrains). Although the ratio is not specified, approximately 2.5 is considered by the Government to be the minimum level to induce farmers to use fertilizers. By way of illustration, Table 2 gives figures on the price of urea and the economics of its application, along with data on the consumption of nitrogen and the percentage growth over the previous year.

As the table shows, when the price of urea rose suddenly in 1974-75, consumption fell. However, in subsequent years, prices were brought down, and there was a sharp growth in consumption—100 percent in four years. Then, in 1979-80, notwithstanding further reductions in prices, there was only a marginal increase in usage, the reason being adverse weather. From 1980-81 on, the price of fertilizers went up, lowering the rate of return of growth of earlier years. Even so, consumption continued to increase, although at the slower rate. While the price increase was one cause in the slowdown, adverse weather also contributed.

Table 2: PRICE OF UREA, RELATIONSHIP OF UREA AND FOODGRAIN PRICES, CONSUMPTION OF NITROGEN AND ANNUAL GROWTH IN CONSUMPTION, 1973/74-1983/84

<table>
<thead>
<tr>
<th>Year</th>
<th>Price of urea Rs./ton</th>
<th>Kgs. required to buy 1 kg. of N</th>
<th>Consumption of N (million tons)</th>
<th>% variation over previous year</th>
</tr>
</thead>
<tbody>
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<td></td>
<td></td>
<td>Wheat</td>
<td>Paddy</td>
<td></td>
</tr>
<tr>
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<td>3.26</td>
<td>1.829</td>
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<td>2,000</td>
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<td>5.88</td>
<td>1.766</td>
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<tr>
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<td>3.83</td>
<td>5.43</td>
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<td>1,750</td>
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<td>1,550</td>
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<td>(11/77)</td>
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<tr>
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<tr>
<td>1980-81</td>
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<td>4.18</td>
<td>3.678</td>
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<td>(6/80)</td>
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<tr>
<td>1981-82</td>
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<tr>
<td>1982-83</td>
<td>2,350</td>
<td>3.60</td>
<td>4.19</td>
<td>4.263</td>
</tr>
<tr>
<td>1983-84 (est.)</td>
<td>2,150</td>
<td>3.09</td>
<td>3.54</td>
<td>4.800</td>
</tr>
</tbody>
</table>

Source: Fertiliser News, Fertiliser Association of India, New Delhi.
Concerned at the slower rate of growth, in June 1983 the Government brought prices down by about 7.5 percent, creating a further incentive to consumption. This move, coupled with a good monsoon, has led to expectations of significantly higher growth.

Because the Government's policy was to set a uniform consumer price for fertilizers throughout the country, the realization of the various units was also uniform, regardless of their production costs and distribution margins, which differed widely. This pricing policy, when combined with the rising costs of investment and inputs, threatened the viability of the fertilizer industry. The Government therefore decided to design another pricing system that would, on the one hand, support the interests of the agricultural community and, on the other, ensure the viability and growth of the fertilizer industry. In 1976, the Government appointed a high-level Fertiliser Prices Committee, which included representatives of industry and various ministries. The committee submitted its report in two parts. Part I, issued in 1977, covered nitrogenous fertilizers. Part II, which addressed the complex fertilizers and allied matters such as distribution margin and equated freight, was presented in 1978.

Recognizing the need to maintain consumer prices of fertilizers at reasonably low levels to encourage consumption, the Committee recommended a system of ex-factory retention prices for the fertilizer industry to ensure the industry's growth. As a result, nitrogenous fertilizers were brought under a retention price scheme beginning November 1, 1977, complex triple super phosphates on February 1, 1979. Under this scheme, still being used, a fair ex-factory price is fixed for each unit on the basis of a normative cost of production, plus equated freight for each unit. The Government either takes back from or pays to each plant an amount equal to the difference between the net realization (consumer price minus the distribution margin) and the retention price plus equated freight.

III. EX-FACTORY PRICING

The Government establishes fair ex-factory or retention prices for the products of each plant. As presently structured, the ex-factory pricing system is designed to provide each plant with a reasonable return on investment, achievable if certain production norms are met. In fixing the retention price, a reasonable price is assured to promote further growth of the industry, assuming efficient levels of operation. However, depending upon the vintage, feedstock and location, etc., of a plant, there is a wide variation in the reasonable cost of production of different units. This varying cost leads to different retention prices. For example, the ratio between the lowest and highest retention prices of urea is as much as 1:2. Fixing a uniform retention price based on an average cost of production (which would be somewhere between the lowest and the highest cost of production) would result in windfall profits for certain units and losses to others. Moreover, while the consumer price remains
fixed for a reasonable period (two years elapsed between the prior revision on July 11, 1981 and the last revision on June 29, 1983), the input prices (raw materials and utilities) increase from time to time. In such a situation, unless the impact of the increase in the input prices is neutralized, the industry will suffer losses. Keeping the above factors in view, individual retention prices are fixed so that each unit realizes a fair rate for its products at efficient levels of operation.

The buildup of the retention price consists of production costs based on operations at certain prescribed levels of efficiency; these costs include inputs consumed, selling expenses, depreciation, worker bonuses and a reasonable rate of return. A factor is included for increasing costs.

Each element of the retention price is discussed below.

Production costs are based on the analysis of actual costs of production in the year preceding the retention price period and on certain assumptions about normative levels of efficiency relating to capacity utilization and consumption of inputs. The other elements are: prices of inputs; conversion costs; selling expenses; minimum bonuses; depreciation; and return and interest. Added to these is equated freight to block headquarters, based on a rational distribution pattern.

Capacity Utilization. For ammonia plants, a capacity utilization of 80 percent is assumed uniformly. In plants producing only urea, the assumption is that all the ammonia is converted to urea, with the production level fixed on the basis of the consumption norm for ammonia per ton of urea.

For complex fertilizers where the plants also produce their own phosphoric acid, a capacity utilization of 70 percent is used. This rate is lower because an acid plant requires more frequent maintenance. In fixing the production level of urea and complex fertilizers, balancing the ammonia and phosphoric acid at the stipulated level is ensured. For complex fertilizers derived entirely from imported ammonia and phosphoric acid, as in the case of Kandla Expansion, the rate of utilization is 6,000 hours a year per stream, and the hourly rate of production for different products is taken into account. The level of production of ammonia and end products derived in this manner is taken into account in distributing the fixed costs as well as in computing the incidence of interest and return per ton.

Implicit in having norms for capacity utilization are incentives and disincentives for efficient/inefficient operations. If a plant does not meet the norm, it will not realize the desired cost of capital and will need to improve its efficiency. On the other hand, plants that operate at higher than the normative level are more profitable, as the fixed charges will already have been recovered at the normative level of production. This system ensures that, although the Government provides a subsidy, it is not at the same time encouraging inefficiency but is rewarding efficiency.
Consumption of Inputs. Reasonable consumption norms for raw materials and utilities are established based on technical reviews of each plant. Here again, the concept is to provide incentives/disincentives for efficiency/inefficiency. If a plant operates at a lower level of capacity utilization, it not only loses on the fixed costs, it also loses on the variable costs, as the consumption of inputs will be higher than the norm. Conversely, if the unit operates more efficiently, it may get a bonus even on the variable costs, as consumption will be somewhat lower than the norm.

Conversion Costs. The conversion costs incurred during the costed year are taken as fixed by nature. However, there is a provision allowing for a 5 percent a year increase in salaries and wages to cover average increases. Administrative overhead is included under this provision. Factory overhead is adjusted based on capacity utilization. With respect to inventories and chemicals, actual expenditures during the costed year are taken into account. For catalysts, there is an annual charge based on the expected life of each type of catalyst in use and the prevailing price. The allowance for repairs and maintenance is made on a normative basis depending on the vintage of the plant. Higher maintenance expenditures are assigned for older plants, lower ones for newer plants.

Selling Expenses. Selling expenses, which involve wages, market development, promotion and publicity, are taken into account as incurred during the costed year.

Minimum Bonus. An allowance is made for any statutorily fixed minimum bonus (the bonus is in the nature of a deferred wage). However, payments of bonuses beyond the statutory minimums are not taken into account, even though they are mandatory under the Bonus Act. The reason is that these payments are considered to be profit-sharing.

Depreciation. Depreciation is handled by the written down value method converted into the straight line method, using the rates specified in the Income Tax Act.

Fair Rate of Return and Interest. A profit margin of 12 percent post-tax (27.507 percent pre-tax) return on net worth is allowed. To derive net worth, the capital employed in the business is divided between equity plus free reserves, which is net worth, and borrowed funds, on the basis of the latest published balance sheet of the plant at the end of the costed year. In determining the capital employed, normative and not actual working capital is taken into account. The net worth of the unit is defined as share capital plus retained earnings minus capital employed outside the business. Interest on borrowings is calculated based on the average rate for various loans.

Changes in Costs. There is a provision for updating the retention prices to take into account any variations in the costs of the inputs from time to time.
EQUATED FREIGHT

Based on a rational distribution program specified by the Ministry of Agriculture, a reasonable freight allowance is fixed for each plant. This allowance is adjusted from time to time depending on changes in railway freight charges and the lead of traffic. Payment for equated freight is made in addition to the retention price.

IV. DISTRIBUTION MARGIN

The Government fixes the distribution margin for both institutional and private dealers. At present, private traders are allowed Rs. 130 and Rs. 190 a ton of urea and DAP, respectively, while institutional agencies get Rs. 20 a ton more. The institutional agencies get a higher margin because of the larger costs they incur from serving the interior. The margin includes a profit on investment in trade, inventory costs, secondary transportation from block headquarters to the interior, storage charges and handling losses.

Until recently, each distributor, institutional or private, had the same margin, irrespective of the season and the consequent differences in carrying costs. As a result, distributors tended to move fertilizers only during the busy season, in an effort to minimize their inventory carrying costs. Since 1983, the margins have been adjusted according to the time of the year, with lower margins applicable in the busy season and higher ones in the off season, commensurate with inventory carrying costs up to the time of consumption by farmers.

V. FERTILIZER SUBSIDY

Where the net realization (consumer price minus dealers' margin) is less than the retention price and equated freight, the Government pays the difference to the manufacturers to ensure the set rate of return on investment. On the other hand, if the net realization is higher, the manufacturer pays the difference to the Government so that it does not reap any unintended benefit.

The net amount of the subsidies paid for indigenous fertilizers since 1979-80 has been growing steadily, as these figures show:
The main reasons for the growth in the subsidy are as follows. First, there has been a significant increase in production from 1981-82 on, as the figures below show. Even if the retention prices had not been revised upwards, as described later, the increased volume would have resulted in a larger total subsidy.

Further, beginning on June 29, 1983, the consumer price of urea was reduced by Rs. 200 a ton, with corresponding reductions for other products. The resulting decrease in the net realization price led in turn to higher subsidies.

Another factor is that more output has come from the newer units, whose capital costs have been significantly higher, as seen in the following figures for ammonia-urea plants.
Consequently, for newly commissioned plants, both the cost of capital (return and interest) and depreciation have been significantly higher than for older plants. The result is higher subsidies per unit of production.

Similarly, the costs of inputs have gone up sharply, as indicated below:

<table>
<thead>
<tr>
<th>Input</th>
<th>1979</th>
<th>1982</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naphtha (Rs./ton)</td>
<td>756</td>
<td>1,931</td>
</tr>
<tr>
<td>Gas (Rs./'000/m³)</td>
<td>138</td>
<td>1,790</td>
</tr>
<tr>
<td>(IFFCO)</td>
<td>(RCF, Trombay-V)</td>
<td></td>
</tr>
<tr>
<td>Power (P/kwh)—Kanpur</td>
<td>27.4</td>
<td>47.8</td>
</tr>
<tr>
<td>Interest (%) on short-term loans</td>
<td>14.5</td>
<td>19.5</td>
</tr>
<tr>
<td>Rock phosphate (Rs./ton)</td>
<td>461</td>
<td>795</td>
</tr>
<tr>
<td>Sulphur (Rs./ton)</td>
<td>817</td>
<td>1,312</td>
</tr>
<tr>
<td>Phosphoric acid (Rs./ton)</td>
<td>3,158</td>
<td>5,393</td>
</tr>
</tbody>
</table>

Wages and the costs of spare parts, etc. have likewise risen substantially.

Increases in the distribution margin and equated freight costs are further factors. The distribution margin was revised upward in August 1981 and again on May 20, 1983. Given that the consumer price has remained fixed, net realization has gone down. Again, the result has been higher subsidies. Similarly, since 1980, there has been an upward revision for railway freight of about 92-95 percent, resulting in higher freight subsidies.

VI. EVALUATION OF THE EX-FACTORY PRICING SYSTEM

The following figures provide some indication of the success of the system in terms of the objectives of increasing fertilizer consumption and encouraging growth in industry. There has been a significant increase in installed capacity, production and consumption of fertilizers, as well as in the yield of paddy and wheat per hectare. The system has also enabled India to reduce its dependence on imports, which have fallen dramatically—from a peak of 1.963 million tons of nitrogen and phosphorus in 1980-81 to 0.488 million tons in 1982-83. The formula provides an incentive for optimizing the operational efficiency beyond 80 percent capacity utilization and for bringing down the unit cost of production. It also provides a strong incentive to units to expand their capital base by modernizing and enlarging their operations. Further, it allows a comparatively high cash flow in the initial years of operation of a new unit, when its debt service obligations are heavy.
<table>
<thead>
<tr>
<th></th>
<th>1975-76</th>
<th>1982-83</th>
<th>Variation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installed capacity ('000 tons):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N₂</td>
<td>2,509</td>
<td>5,322</td>
<td>112</td>
</tr>
<tr>
<td>P₂O₅</td>
<td>692</td>
<td>1,563</td>
<td>126</td>
</tr>
<tr>
<td>Production ('000 tons):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N₂</td>
<td>1,535</td>
<td>3,430</td>
<td>123</td>
</tr>
<tr>
<td>P₂O₅</td>
<td>320</td>
<td>984</td>
<td>207</td>
</tr>
<tr>
<td>Total consumption ('000 tons):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N₂</td>
<td>2,149</td>
<td>4,263</td>
<td>98</td>
</tr>
<tr>
<td>P₂O₅</td>
<td>467</td>
<td>1,420</td>
<td>204</td>
</tr>
<tr>
<td>Average consumption (kg.) of all nutrients per hectare of gross cropped area</td>
<td>16.93</td>
<td>36.6</td>
<td>116</td>
</tr>
<tr>
<td>Average yield per hectare (in kg.):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paddy</td>
<td>1,235</td>
<td>1,338a/</td>
<td>8.34</td>
</tr>
<tr>
<td>Wheat</td>
<td>1,410</td>
<td>1,649a/</td>
<td>16.95</td>
</tr>
<tr>
<td>a/ Data for 1980/81.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Costs of Imported and Indigenous Fertilizers**

Until 1981-82, India imported large quantities of fertilizers because of the wide gap between demand and domestic production. As domestic production rose significantly in 1981-83, the level of imports fell commensurately. This shift was a high priority, not only because of the scarcity of foreign exchange, but because the prices of imported fertilizers have generally been higher.

On the whole, the Government believes that its retention prices are in line with international equilibrium prices. By way of illustration, the comparative prices, inclusive of handling charges, for imported urea and domestic urea, based on an average retention price plus equated freight, are shown below:

<table>
<thead>
<tr>
<th>Year</th>
<th>Average cost (Rs./ton) of Imported urea</th>
<th>Average cost (Rs./ton) of Indigenous urea</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979-80</td>
<td>2,194</td>
<td>1,848</td>
</tr>
<tr>
<td>1980-81</td>
<td>2,731</td>
<td>2,016</td>
</tr>
<tr>
<td>1981-82</td>
<td>3,026</td>
<td>2,541</td>
</tr>
<tr>
<td>1982-83</td>
<td>2,768</td>
<td>2,909</td>
</tr>
</tbody>
</table>
Up to 1981-82, the cost of imported urea was significantly higher than domestic urea. However, in 1982-83, the situation was reversed. There were two primary reasons. First, the average cost of production of indigenous urea increased significantly because of greater production from the new, higher cost plants and the steep increase in the cost of inputs. Second, at the same time the international price of urea fell sharply because of an overall glut in the international market. For example, in 1980-81, the f.o.b. price of bulk urea was in the range of US$190-225 a ton, whereas in 1983 it was US$112-135 a ton. Even the freight costs dropped from US$54-64 in 1981 to US$33-37 in 1983.

Because of the lower price for imports, it is sometimes suggested that importing would be cheaper than increasing production at the high cost plants. This conclusion is not valid. First, the reduction in India's imports was an important factor in creating the surplus. Second, in part for that reason, the glut is presumably temporary. India cannot base its long-term planning of supplies on temporary declines in international prices. In fact, as India has imported slightly more in the current year, prices have already shown signs of increasing. Third, developing countries like India face acute shortages of foreign exchange. Long-term planning has to be aimed at achieving a reasonable degree of self-sufficiency to conserve foreign exchange, particularly when raw materials (such as gas for nitrogenous fertilizers) are available indigenously. Finally, as mentioned earlier, the increase in the average cost of production is the result of increased production at recently commissioned plants and of the steep increase in input prices. It is inappropriate to compare the costs of production at these newer plants with the cost of imports from countries having old plants. Similarly, the prices of inputs are not comparable. For instance, the price of gas, particularly in the Gulf countries, is very low as compared to India, as is true for naphtha and fuel oil.

VII. OPTIONS FOR LOWERING THE SUBSIDY

As noted, the level of the subsidy has been increasing sharply, imposing a significant burden on the budget. Concerned over the ever-growing subsidy bill, the Government has been exploring ways to reduce it. Some options are discussed below.

Ending Taxes and Duties on Equipment

One reason for the increased subsidy has been the high capital cost of newly commissioned plants. Apart from inflation, one major factor has been the customs and excise duties on imported and indigenous equipment. These fees force up the capital costs of construction, as well as of financing. Thus, what is recovered as taxes is paid back as excess capital costs. In short, these fees do not constitute a net resource to the Government. Precisely for this reason, in June 1980 the Government ended the excise duties and Fertiliser Pool Equalisation Charge on fertilizers.
A further point is that, to the extent these factors increase the costs of a project, the retention price buildup will include a recurring additional subsidy liability for the increased depreciation, rate of return and interest resulting from the higher capital cost.

The savings that would result from eliminating the import fees and related financing costs are given below for one of the major projects in the public sector. The estimated cost of the project is around Rs. 900 crores. Ending these expenses could lower the project cost as follows:

- Eliminating customs duties and related financing charges—Rs. 112 crores.
- Eliminating the excise duty and related financing charges—Rs. 33.5 crores.

Collection of the customs duties and excise taxes would yield the Government up to about Rs. 125.9 crores (96.9 and 29.0, respectively). However, the capital cost would go up by about Rs. 145.51 crores, of which financing charges would be about Rs. 19.61 crores. The additional subsidy for the higher depreciation, return and interest in the retention price buildup would be about Rs. 462 crores over a 10-year period. In terms of present value, while the capital cost would increase by Rs. 108.64 crores at a 12 percent discount factor, the present value of the additional subsidy would be Rs. 174.84 crores.

These figures were based on the following. An average rate of depreciation of 10 percent a year was assumed. The debt equity ratio was taken as 1:1, the level used for public sector plants. The return on net worth was taken as 12 percent post-tax or 27.51 percent pre-tax. The average interest rate during construction for computing the financing charges was set at 15.5 percent because of certain higher interest loans from Persian Gulf countries.

Clearly, by charging customs duties and excise taxes, not only do additional resources have to be found for financing the project, but the ex-factory price subsidy rises on a recurring basis because the charges for depreciation, return and interest in the retention price buildup will go up.

These conclusions apply equally to private sector units. The only differences are that:

- The extra resources to finance the increased capital cost of the project have to be procured mainly from Government-owned financial institutions; and
- Because of the higher debt equity ratio, while the return on net worth goes down slightly, the interest during construction goes up and, consequently, the interest and depreciation in the retention price also go up, and on a recurring basis.
The Government is now studying the possibility of exempting the fertilizer industry from the customs duties and excise taxes. These charges should be eliminated. Should this move create problems with respect to other sectors, an option is to reimburse the fertilizer plants for import levies through a one-time grant. Either approach would reduce the recurring subsidy.

**Increasing the Debt/Equity Ratio**

At present, public sector projects are financed on the basis of a debt equity ratio of 1:1, whereas in the private sector it is generally 4:1 or, at best, 3:1. In the retention price, equity is remunerated at 12 percent post-tax or 27.507 percent pre-tax, while loans are eligible for interest/coverage at 12 percent in the case of the public sector and around 14 percent in the case of the private sector. Thus, the higher the equity component, the higher the subsidy burden. Since the Government bears the entire capital cost of public sector plants, it should not have to incur a larger recurring subsidy burden because of the high equity base.

An alternative approach is to change the debt equity ratio for public sector plants from 1:1 to 2:1 or 3:1. This shift may increase marginally the interest during construction (which is divided in the ratio of 1:1 at present). However, that increase would be more than offset by the savings in the subsidy, both in financial terms and with respect to present value, computed at a 12 percent discount factor.

The public sector project used earlier again provides a useful example. Half of the investment of about Rs. 900 crores would be equity, the remaining half loans. Both would come from the Government. If the debt equity ratio were increased to 2:1, the total savings in the subsidy over the 10 years following commissioning of the plant would be about Rs. 245 crores. If the debt equity ratio were 3:1, the savings would be about Rs. 368 crores. In terms of present value, the savings in the subsidy would be about Rs. 93 and Rs. 139 crores, respectively.

Raising the ratio would also increase the accountability of those overseeing implementation of the project, as every day of overrun during construction would lead to a higher interest burden. Authorities would have to be more vigilant to ensure that cost overruns resulting from time overruns did not erode profitability.

For capital-intensive projects such as fertilizer plants in the public sector, the debt equity ratio should be changed to 2:1 or 3:1.

**Natural Gas Prices**

Earlier the price of natural/associated gas was fixed on the basis of the cost of production and a reasonable return on investment. Until 1978 IFFCO Kalol paid Rs. 138 per 1,000 m$^3$ as the landed cost of gas. In 1979, this figure was revised upwards, and until March 1982 it paid Rs. 342 per 1,000 m$^3$. In the same period, HFC Numrup was paying Rs. 267 per 1,000 m$^3$. On the other hand, RCF Trombay was paying Rs. 1,791
per 1,000 m$^3$ for the Trombay V unit and Rs. 1,637 per 1,000 m$^3$ for the Trombay II unit (the latter was lower because of a rebate allowed for capital investment to facilitate conversion from naphtha to gas). The RCF Trombay price was much higher because it was set based on naphtha equivalent. Thus the price was not related to the cost of production of gas. In the end, the gas price unnecessarily inflated the cost of production of fertilizers and in turn increased the subsidy burden.

The main reason for charging gas prices on the basis of the replacement value of naphtha for feedstock and of fuel oil for fuel energy was to ensure an efficient allocation of natural gas among various uses and to promote the broad objectives of the national energy policy, especially with respect to conservation and fuel substitution, and in terms of the resources of the country. However, these considerations do not appear to be valid, as gas is not freely available but is allocated by the Government for different purposes based on the most optimal uses. The Government decided to use gas as a feedstock for fertilizers based on its feedstock policy, which in turn was based on the recommendations of various high-level working groups that were determining the optimum utilization of gas.

A final point is that, from the perspective of the economy as a whole, under the present system there is no increase in investible resources in real terms, as the extra price of the Oil and Natural Gas Commission is offset by the extra subsidy paid by the Government.

Since consumers do not have a choice of utilizing gas as they like, unlike with other commodities, the principle of "value to the user" does not appear to be relevant in the fertilizer sector. What is relevant is generating the investible surpluses required for a large investment program. To achieve this objective, gas should be priced on its own, with a reasonable return that promotes investment, rather than basing the price on some pre-conceived notion about equivalence with other feedstocks such as naphtha and fuel oil. This modification is particularly important for the fertilizer sector, given the huge subsidy and the impact of increases in the costs of inputs, including gas. Similarly, it is necessary to fix the prices of naphtha and fuel oil on their own merits rather than basing them on international prices.

**Rationalizing Transport**

Until the retention price scheme was introduced, manufacturers bore the cost of transportation. Consequently, there was no serious effort to rationalize movement; the manufacturers simply tried to meet the demand of different states from whatever source possible.

With the introduction of the subsidy scheme, the cost of transportation has been relevant, and efforts have been made to rationalize the distribution of fertilizers from different plants in the economical marketing zones of each plant. In particular, criss-cross transport has been eliminated to reduce the length of hauls and the cost of transportation. An important measure taken to eliminate criss-cross
movements was to encourage manufacturers to set up product exchange arrangements so that, without disturbing their traditional marketing network, they can avoid criss-crossing.

The net effect of the measures to rationalize plant locations and transportation has been a gradual reduction in the average haul for fertilizers, as is seen in the following figures:

<table>
<thead>
<tr>
<th>Year</th>
<th>Average haul (km.) per ton of fertilizers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979-80</td>
<td>1,126</td>
</tr>
<tr>
<td>1980-81</td>
<td>1,100</td>
</tr>
<tr>
<td>1981-82</td>
<td>1,010</td>
</tr>
<tr>
<td>1982-83</td>
<td>949</td>
</tr>
</tbody>
</table>

Further efforts are being made to optimize the railway/road mix in terms of total transportation costs. Thus rail or road is selected based on relative economics. This approach is a departure from the traditional concept of moving fertilizers by rail even though the cost was higher. Basically, shipping long distances is handled by rail, while secondary transfers from nodal points and short hauls take place by road.

**Efficient Use**

Chemical fertilizers are costly. Therefore, from the point of view of both the economy and farmers' profits, the need for economical use of fertilizers cannot be overemphasized. This issue, however, is mainly relevant when large amounts of nutrients are used, generally not the situation in India. Nevertheless, both the State extension network and the manufacturers make extensive efforts to promote efficient application, in part through demonstrations. In addition, soil samples are analyzed to determine the correct dosages of different nutrients.
Chapter 9

THE PRICING OF FERTILIZERS IN INDIA

H. S. Bawa
Executive President
Zuari Agro Chemicals Ltd.

I. THE NEED FOR CONSUMER PRICE CONTROLS

A large segment of India's vast rural population lives below the subsistence level. As such, the Government has made foodgrains available to this section of the society at a reasonable price through a public distribution system. The procurement price for staple foodgrains such as wheat and rice, which the Government sets periodically, is linked to the cost of all inputs required by a farmer, including chemical fertilizers, and to crop yields. The price to farmers of all nutrients must therefore be pegged at a level consistent with the support price for foodgrains fixed by the Government. Since a large number of farmers in India have no surplus produce to sell in the marketplace, the need for reasonable price levels for chemical fertilizers assumes even greater importance.

While thus protecting the interests of farmers and the weaker sections of society, the Government has also to ensure that the manufacturers of nitrogenous and compound fertilizers earn a fair return on their investments, thus encouraging indigenous production and thereby ensuring adequate supplies at the proper time and place.

As such, the two basic goals that a pricing system for fertilizers in India must meet are:

- A reasonable and uniform price for fertilizers throughout the country.
- A fair return to manufacturers that would encourage growth in the industry, an underpinning of India's economic development.

II. EX-FACTORY PRICING

The primary objective of the ex-factory pricing policy is to ensure efficient operations and a fair return on investment. The Government has available several options:

- Fixing a single average ex-factory price for all manufacturers in the country.
- Grouping various manufacturers on the basis of plant vintage and feedstock and fixing a different average ex-factory price for each category.
o Using a two-tier pricing system based on the ability of the consumer to pay.

o Fixing the ex-factory price for individual units based on vintage, feedstock and other factors that influence efficiency.

In view of the highly capital-intensive nature of the fertilizer industry and the steep disparity in the capital costs of pre- and post-1973 units, a single average price for the entire industry would be very inequitable. Older plants would earn a disproportionately high return on investment, whereas newer plants, built at significantly higher costs, would hardly be viable. The same situation would apply to an average price for groups of plants. Either system would discourage new investment and stunt the growth of the indigenous fertilizer industry, leading to greater dependence on imports.

As to a two-tier pricing system, the *sine qua non* is to identify the class of farmers who require fertilizers at concessional terms by virtue of the size of their holdings, soil conditions, irrigation, cropping patterns, etc. Besides the subjectivity inherent in that categorization, this system would pose serious administrative problems. The distribution system would be subject to malpractice, and it would be difficult to guarantee adequate supplies of fertilizers at the lower prices prescribed for small, poorer farmers. The pricing would also have to be linked to a system of rural credit, necessitating another complex administrative requirement. As such, a two-tier pricing system does not appear to be feasible.

India has chosen the fourth option, involving a retention or ex-factory price for each individual manufacturing unit. The salient features of the system, which has evolved over the years, are:

o A uniform consumer price for each type of fertilizer throughout the country.

o A post-tax return of 12 percent (pre-tax 27.5 percent) on net worth, defined as the shareholders' paid-up capital (equity and preference) and the retained earnings of the company. The rate also assumes certain operating norms. For the ammonia plants, capacity utilization is set at 80 percent. In the case of units manufacturing complex fertilizers using imported phosphoric acid, capacity utilization is based on 6,000 stream-hours. The hourly rate of production of different grades is based on plant design and actual performance.

o The retention price for individual units is determined once in three years. The fixed and variable costs of production, including interest and depreciation, are determined on a normative basis, as discussed later.
The freight costs incurred by individual companies to move the fertilizers to the retail outlets are reimbursed, assuming that the distance has been kept to a minimum and that the optimum mix of rail/road was used.

The retention price is computed as follows:

1. The rate of consumption of all raw materials, catalysts, chemicals, utilities, etc., is based on an in-depth study of each plant by the technical staff of the Fertiliser Industry Coordination Committee (FICC), which administers the fertilizer pricing system. The study is conducted once every three years in the year preceding the three-year pricing cycle. Consumption norms are fixed so as to promote operational efficiency and taking into account specific constraints faced by individual units.

2. Conversion costs and selling and administrative expenses are based on actual expenses in the year preceding the pricing period. A provision for cost escalation of 5 percent a year on salaries and wages is allowed.

3. The average interest rates paid on borrowed funds and depreciation are those established in the income tax laws.

4. A profit margin is built into the retention price that should yield a post-tax return of 12 percent on net worth. Computation of net worth, and the sources and application of funds, are based on the latest balance sheet of each unit.

III. ADEQUACY OF THE PRICING SYSTEM

The retention price system is conceptually sound and by and large encourages the growth of indigenous manufacturing capacity. Nevertheless, the following need to be re-examined if the goal of self-sufficiency in foodgrains and exportable surpluses is to be supported by adequate domestic fertilizer supplies.

1. The post-tax return of 12 percent on net worth does not provide the public with adequate incentive to invest in fertilizer companies. Convertible/non-convertible debentures, fixed deposits with companies at 15 percent interest and similar opportunities are far more attractive. Greater incentives are necessary if the highly capital-intensive fertilizer industry, with its long gestation periods and operating risks, is to raise the required capital.

2. The capital employed by a company is computed by taking shareholders' funds and borrowings less the capital works in progress. Thus, when a company is expanding its facilities on the basis of retained earnings, its net worth is reduced until the expansion is completed. Similarly, when an existing company starts a new company, its net worth is reduced permanently to the extent that it invests its earnings in the new
company. Since the gestation period for fertilizer plants is relatively long, exclusion of funds deployed in capital works from net worth is inconsistent with the objective of encouraging growth in the industry. No downward adjustment in net worth should be made for the expansion and promotion of a new fertilizer company.

(3) Given the rate of inflation and the consequent increase in fixed and variable costs, fixing the retention prices only once every three years does not allow for full compensation of costs. In addition, since net worth is frozen for three years, the retained earnings of a company do not earn any return during this period. While this system does protect companies that may incur a loss, it does not reward efficient units. On the other hand, there are practical difficulties in computing retention prices annually.

The industry recommends that net worth be revised in the second and third years to reflect major factors such as accumulated surplus, depreciation and expenditures on repairs and maintenance, as stated in the company's balance sheet for the previous year. Alternatively, accruals by way of retained earnings based on the 12 percent post-tax return, less the amount paid out as dividends, could be considered in the case of companies that have operated above the benchmark capacity reported in the annual accounts.

By way of illustration:

<table>
<thead>
<tr>
<th></th>
<th>1982-83</th>
<th>1983-84</th>
<th>1984-85</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Net worth of Company &quot;A&quot; at beginning of pricing period</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share capital: Equity</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Preference</td>
<td>30.0</td>
<td>30.0</td>
<td>30.0</td>
</tr>
<tr>
<td>Retained earnings</td>
<td>170.0</td>
<td>170.0</td>
<td>170.0</td>
</tr>
<tr>
<td><strong>2. Return at 12% (post-tax)</strong></td>
<td>36.0</td>
<td>36.0</td>
<td>36.0</td>
</tr>
<tr>
<td><strong>3. Dividend payment to equity (15%) and preference (10%) to shareholders</strong></td>
<td>18.0</td>
<td>18.0</td>
<td>18.0</td>
</tr>
<tr>
<td><strong>4. Retained earnings</strong></td>
<td>18.0</td>
<td>36.0</td>
<td>54.0</td>
</tr>
<tr>
<td><strong>5. Accruals to net worth (cumulative)</strong></td>
<td>18.0</td>
<td>36.0</td>
<td>54.0</td>
</tr>
<tr>
<td><strong>6. Return on accruals at pre-tax rate of 27.5%</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Additional income</td>
<td></td>
<td></td>
<td>14.85</td>
</tr>
</tbody>
</table>

\( ^a/ \) Return on this is not assumed in the above computation.
(4) A company's cash surplus is deducted from net worth, as those surpluses are normally kept as short-term deposits in banks and earn returns. However, the short-term bank interest rate is very low (3-5 percent), and it is therefore not fair to exclude the cash surplus from net worth. An alternative is to accept that an efficiently run unit will be left with a cash surplus that it will invest when the opportunity arises. As such, cash surpluses should be considered part of the shareholders' funds. In fact, they are held to ensure that when assets and technology become obsolete, they can be replaced to achieve minimum normative capacity or to expand or set up new plants.

(5) Repairs and maintenance expenses for individual companies are set on the basis of a fixed percentage of the first cost of the plant and machinery. To some extent, this provision takes into account plant vintage and price escalation. However, it does not provide adequate allowance for older units, given the very steep increase in the costs of labor and materials. In addition, the impact of inflation during the three-year pricing period is not taken into account. For example, the cost of spare parts for rotating equipment has increased three- to fourfold over the last three years; the price of even carbon steel spare parts (such as tube bundles) has nearly doubled in the last two years. If repairs and maintenance run higher than allowed, the profitability of fertilizer companies can be seriously eroded. The present basis for establishing the repair and maintenance costs of each unit needs to be examined. To ensure efficient use of funds for these purposes, the FICC can stipulate realistic norms for each unit.

(6) Depreciation is allowed on an average basis using a straight line method for the pricing period. This method does not take into account replacement costs and has created an anomalous situation in which the depreciation allowed for new units is relatively more realistic as compared to older units. Further, although depreciation of additions to capital equipment is reflected in the retention price, the cost of financing this capital outlay is not allowed. It is suggested that a replacement cost basis be adopted.

(7) The accounting practice is to charge catalysts in the books when replaced. However, when computing the retention price, the cost of catalysts is derived on the basis of the actual cost of the different catalysts held in stock. As such, these costs are not fully recovered, even when the catalysts are changed after 15 and 18 months in the course of normal operations. The table below shows the trend in catalyst prices over the last three years. The increases in the prices of catalysts have a direct bearing on normative working capital as well.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary reformer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICI 46 - 1</td>
<td>209</td>
<td>209</td>
<td>288</td>
<td>364</td>
</tr>
<tr>
<td>ICI 46 - 4</td>
<td>210</td>
<td>210</td>
<td>256</td>
<td>355</td>
</tr>
<tr>
<td>LSK - LT</td>
<td>-</td>
<td>-</td>
<td>84</td>
<td>144</td>
</tr>
<tr>
<td>CCI-C11-4</td>
<td>76</td>
<td>-</td>
<td>80</td>
<td>121</td>
</tr>
<tr>
<td>CCI-C12-1</td>
<td>-</td>
<td>-</td>
<td>33</td>
<td>78</td>
</tr>
<tr>
<td>CCI-C15-1</td>
<td>-</td>
<td>-</td>
<td>76</td>
<td>180</td>
</tr>
</tbody>
</table>

- = Not available.

The FICC should allow this cost on a replacement basis.

(8) The overhead for manufacturing, administration and sales excludes charities and donations, insurance for losses of profits, legal fees related to tax disputes, and profit-sharing bonuses in excess of the statutory minimum, as well as other items. Thus the allowable overhead is not realistic. A major area of loss to manufacturers is the premium for insurance to cover losses of profits resulting from fires. This premium constitutes a sizable portion of the total insurance bill. Disallowing it is not fair, since the FICC does not compensate the company in any other manner for losses incurred from fires.

(9) The Payment of Bonus Act requires that a company pay a bonus of up to 20 percent to its workers if its earned profits are above a certain level stipulated in the law. However, the FICC only recognizes the minimum bonus of 8.33 percent payable under the law. Since companies have to pay the 20 percent bonus at the 12 percent post-tax return earned at 80 percent capacity utilization, it is unfair to peg the bonus to the minimum level.

Similarly, the provision of only a 5 percent escalation for salaries and wages, and the lack of a provision for increases in other expenses such as travel, sales promotion and canteens, lead to under-recoveries.

(10) Retail fertilizer dealers usually perform various services such as transportation, storage, inventory holding, supervision, publicity and provision of credit. The fertilizer manufacturer repays them for these services by means of a dealer margin. The Government fixes the dealer margins and the maximum prices of fertilizers to consumers as follows:
<table>
<thead>
<tr>
<th>Product</th>
<th>Maximum consumer price in Rs./ton</th>
<th>Dealer margin % of consumer price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urea</td>
<td>2,150</td>
<td>130</td>
</tr>
<tr>
<td>Uramphos (28:28:0)</td>
<td>3,350</td>
<td>165</td>
</tr>
<tr>
<td>Sampurna (19:19:19)</td>
<td>2,750</td>
<td>160</td>
</tr>
</tbody>
</table>

Experience shows that the actual cost of the dealers' services is higher than the allowed margin. Consequently, there is little incentive for taking up dealerships, unlike in other areas such as oil company dealerships. This situation is unfortunate, as fertilizer dealers are the front line for manufacturers' marketing. In fact, dealers are trained to serve as "change agents," bringing new and improved technology to farmers. Because of the limited margins, fertilizer dealerships are only viable if other allied product lines such as pesticides, seeds or rice milling are also sold.

Moreover, margins have not been keeping pace with inflation. In 1971, the dealer margin at Rs. 72 a ton was 8 percent of the urea consumer price of Rs. 923 a ton. Today's margin of Rs. 130 is only 6 percent of the urea consumer price of Rs. 2,150 a ton. Because of the inadequate dealer margins, fertilizer companies are forced to underwrite some of the dealers' expenses during the off season. More incentives are needed to bring dealers into the industry.

Given these various issues, the 12 percent post-tax return is in fact pertinent to a capacity utilization of 83-84 percent at an ammonia plant, instead of the benchmark of 80 percent.

IV. THE RISING SUBSIDY BILL

Because of the increase in the capital costs of new fertilizer plants and in the costs of inputs for different grades of fertilizers, the Government's subsidy bill has been growing steadily—from Rs. 3,210 million in 1978-79 to a projected Rs. 9,000 million in 1983-84. Holding it down can be achieved by changing the consumer prices for fertilizers and the procurement prices for foodgrains. Other means are:

1. The capital costs of new projects can be reduced by exempting imported equipment from customs duties and other levies. This step would not result in a loss of revenue to the Government, as the subsidies would also go down. Moreover, it would release scarce resources for other development work, as the capital costs of the massive fertilizer complexes proposed to be built in the next few years will be 15 to 20 percent lower.
(2) New plants should be based on the latest technology, with low energy requirements and more efficient conversion processes, to reduce operating and maintenance costs. Using the latest technology is not likely to increase capital costs.

(3) Bagging/dispatching and other labor-intensive steps in new plants should be mechanized to the extent possible to reduce operating costs.

(4) The price of gas feedstock should be based on the cost of its production and distribution, instead of on alternative fuel parities (e.g., the naphtha equivalent principle, which links the gas price with the equivalent price of naphtha).

(5) An all-out effort should be made to reduce the construction time of new projects and to ensure their completion on schedule to avoid cost overruns.

V. CONCLUSIONS

The basic philosophy of protecting the farmer and the industry by fixing fertilizer prices is sound. This is evidenced by the increase in the consumption of fertilizers and in the production of foodgrains over the last decade on the one hand, and in the growth in indigenous manufacturing capacity on the other. However, to encourage the continued growth of agriculture and of the economy, which is so dependent on it, the pricing parameters need to be made more realistic to allow a fair and equitable return to industry.
I. INTRODUCTION

Fertilizer use ranks among the most important factors for expanding agricultural production in both developed and developing countries. There is ample evidence that the rising trend in crop yields is directly related to the increased application of fertilizers. Therefore, policy relating to all aspects of fertilizers, e.g., research, production, marketing and prices, has assumed considerable importance.

In Pakistan, fertilizers have contributed significantly to increased agricultural productivity. The Sixth Five-Year Plan (1983-88) accords high priority to increased fertilizer consumption and envisages that 55-70 percent of the incremental production, targeted for wheat, maize, sugarcane and cotton, will be achieved through greater use of nutrients. To this end, total fertilizer consumption is targeted to reach about 1.92 million nutrient tons by 1987-88 (or about 93 kg. per cropped hectare), up from 1.24 million nutrient tons (or 64.4 kg. per cropped hectare) in 1982-83.

The Government of Pakistan routinely addresses issues relating to fertilizer policy, including domestic production, imports and exports, subsidies, supply planning, allocations by crop and region, stock levels and storage, transportation and distribution, and ex-factory and farmgate prices. To promote greater application of fertilizers, pricing of fertilizers is reviewed at regular intervals at the highest levels to ensure that a reasonable balance is maintained between fertilizer and agricultural crop prices.

II. EVOLUTION OF FERTILIZER PRICING

As in many developing countries, Pakistan sets fertilizer prices at two levels. The fertilizer sales price to farmers is regulated to ensure a reasonable relationship to crop prices, thus encouraging greater fertilizer consumption. Prices are also set at the factory level to assure domestic producers a fair rate of return while promoting efficiency, further investment and rationalization. This pricing system has been evolving over the last 30 years, and the Government is continuously trying to improve it.
The Early Years

Promoting Fertilizer Consumption. Fertilizer use was virtually nonexistent in Pakistan until the early 1950s. Crop production was carried out largely through traditional agronomical practices. Because the application of fertilizers and other modern techniques represented radical departures from then-existing practices, initially the Government felt it necessary to offer incentives to induce greater acceptance of fertilizer use, and it therefore subsidized the price of fertilizers to farmers.

The program was quite successful. Subsidizing of fertilizers lessened the burden on farmers' low purchasing power and limited credit availability, allowing them to achieve higher consumption of nutrients. As the benefits of fertilizers became evident, that, too, encouraged greater use. The Government also expanded the educational role of the extension services of the Provincial Agriculture Departments.

The result was that fertilizer consumption grew rapidly. During 1955-56 to 1959-60, it increased threefold to 20,000 nutrient tons. Nevertheless, average fertilizer use per unit of cropped area was still low. A disincentive was the unfavorable ratio of the price of fertilizers to the price of crops produced under the Government's policy of fixing foodgrain prices (mainly wheat) at low levels so that cheap supplies would be available to the urban population. Other problems were that the fertilizer distribution and procurement systems were not sufficiently organized, and domestic production was inadequate, while shortages of foreign exchange hampered imports, resulting in supply shortages. Finally, the institutional arrangements for educating farmers through extension work remained weak. These and other non-price issues, which were equally important in increasing fertilizer consumption, received inadequate attention.

As the key role of fertilizers in stepping up agricultural productivity was recognized, the Government made concerted efforts to remedy the situation. Based on the experience of prior years, the Government undertook a number of measures in the 1960s. The foodgrain pricing policy was modified. Its new goal was not only to safeguard the interests of vocal urban consumers, but also to ensure farmers a reasonable minimum return on their investment. The non-price measures included:

- Institutional strengthening of the agricultural extension service.
- Eliminating the non-educational functions of the extension staff of the Provincial Agriculture Departments, such as the distribution of fertilizers and other agricultural inputs, so that the extension staff would focus solely on educating farmers.
- Establishing, on the recommendation of the Agriculture and Food Commission, an Agricultural Development Corporation to
take over the responsibility for procurement, storage and distribution of farm supplies to streamline the fertilizer distribution system.

- Initiating and gradually expanding the program of soil testing. Based on the test results, farmers were supplied with basic information on the fertilizer requirements of their soils and crops. This step both enhanced farmers' participation and increased their confidence in fertilizer use.

- Improving the availability of credit to farmers. Steps were taken to coordinate the agencies providing rural credit, including a merger of the Agricultural Development Finance Corporation and the Agricultural Bank of Pakistan into one organization called the Agricultural Development Bank of Pakistan. The procedures for obtaining loans were simplified. These steps helped farmers obtain more credit with greater ease and less delay.

Combined with the price incentives provided to farmers through the subsidy on fertilizers, these measures had a salutary effect. Fertilizer consumption more than quadrupled between 1959-60 and 1964-65, reaching about 87,000 nutrient tons.

**Fertilizer Supplies.** Initially, Pakistan relied primarily on imported fertilizers. However, the period between the allocation of foreign exchange for fertilizer imports and delivery often ranged from 9 to 12 months. To avoid sudden shortages in the interim, the Government undertook advance planning of imports. Simultaneously, it sought to reduce dependence on imports by creating additional capacity for domestic production. As Pakistan had abundant supplies of natural gas, and the most efficient feedstock for the production of nitrogenous nutrients, but limited foreign exchange for fertilizer imports, the Government decided to rely more on local production to ensure reliable supplies. Programs were developed to facilitate domestic production, particularly of nitrogenous fertilizers.

**Growth in Consumption.** The Government offered additional incentives to farmers to expand their fertilizer consumption. Non-price measures were given more importance, and the program for fertilizer procurement, distribution, credit and storage was streamlined. One notable change made was to involve private enterprise in the fertilizer distribution system, a plan that increased the retail sale points significantly, enabling farmers to obtain fertilizers nearer their farms. The education programs, the promotional campaign involving field demonstrations, etc., and effective implementation of the crop support price program and other measures also helped expand fertilizer use.

Fertilizer consumption continued to increase at a rapid rate, more than tripling between 1969-70 and 1979-80 from 312,000 nutrient tons to 1.04 million nutrient tons, reflecting an average annual growth rate of
13 percent (Table 1). Considering the relatively high base at the end of the preceding decade, this rate was quite satisfactory. However, this increase, coupled with the ongoing upsurge in the prices of both imported and domestically produced fertilizers, led to a sharp growth in the government's subsidy bill. It rose from about Rs. 615 million in 1977-78 to about Rs. 1,692 million in 1978-79 and Rs. 2,455 million in 1979-80 (Table 2). The growth in the subsidy reduced the availability of resources for other programs and projects and continued to cause serious constraints on the balanced development of the agricultural sector.

Table 1: YEARLY OFFTAKE, GROWTH AND PRICES OF FERTILIZERS, 1965-66 TO 1982-83a/

<table>
<thead>
<tr>
<th>Year</th>
<th>Fertilizer offtake (1'000 tons)</th>
<th>Change over the last year %</th>
<th>Effective date</th>
<th>Fertilizer prices</th>
<th>Change DAP</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nutrients</td>
<td></td>
<td></td>
<td>Urea (Rs./50 kg.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1965-66</td>
<td>71.1</td>
<td>-</td>
<td>6/8/1966</td>
<td>25.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1966-67</td>
<td>116.8</td>
<td>64</td>
<td>-</td>
<td>25.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1967-68</td>
<td>188.6</td>
<td>62</td>
<td>-</td>
<td>25.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1968-69</td>
<td>246.9</td>
<td>31</td>
<td>8/29/68</td>
<td>26.00</td>
<td>4</td>
<td>28.00</td>
</tr>
<tr>
<td>1969-70</td>
<td>311.9</td>
<td>26</td>
<td>6/29/70</td>
<td>28.50</td>
<td>10</td>
<td>28.00</td>
</tr>
<tr>
<td>1970-71</td>
<td>283.2</td>
<td>- 9</td>
<td>-</td>
<td>28.50</td>
<td>-</td>
<td>28.00</td>
</tr>
<tr>
<td>1971-72</td>
<td>381.9</td>
<td>35</td>
<td>-</td>
<td>28.50</td>
<td>-</td>
<td>28.00</td>
</tr>
<tr>
<td>1972-73</td>
<td>436.5</td>
<td>14</td>
<td>9/25/72</td>
<td>35.00</td>
<td>23</td>
<td>35.00</td>
</tr>
<tr>
<td>1973-74</td>
<td>402.7</td>
<td>- 8</td>
<td>3/30/73</td>
<td>42.00</td>
<td>20</td>
<td>44.00</td>
</tr>
<tr>
<td>1974-75</td>
<td>425.5</td>
<td>6</td>
<td>4/20/74</td>
<td>75.00</td>
<td>36</td>
<td>75.00</td>
</tr>
<tr>
<td>1975-76</td>
<td>550.6</td>
<td>29</td>
<td>4/16/76</td>
<td>68.00</td>
<td>-9</td>
<td>72.00</td>
</tr>
<tr>
<td>1976-77</td>
<td>631.3</td>
<td>15</td>
<td>-</td>
<td>68.00</td>
<td>-</td>
<td>72.00</td>
</tr>
<tr>
<td>1977-78</td>
<td>712.2</td>
<td>13</td>
<td>-</td>
<td>68.00</td>
<td>-</td>
<td>72.00</td>
</tr>
<tr>
<td>1978-79</td>
<td>879.5</td>
<td>24</td>
<td>10/17/78</td>
<td>63.00</td>
<td>-7</td>
<td>67.00</td>
</tr>
<tr>
<td>1979-80</td>
<td>1,044.1</td>
<td>19</td>
<td>2/25/80</td>
<td>93.00</td>
<td>48</td>
<td>100.00</td>
</tr>
<tr>
<td>1980-81</td>
<td>1,079.5</td>
<td>3</td>
<td>-</td>
<td>93.00</td>
<td>-</td>
<td>100.00</td>
</tr>
<tr>
<td>1981-82</td>
<td>1,080.0</td>
<td>Negligible</td>
<td>3/15/82</td>
<td>103.00</td>
<td>11</td>
<td>105.00</td>
</tr>
<tr>
<td>1982-83</td>
<td>1,243.66b/</td>
<td>15</td>
<td>10/6/82</td>
<td>118.00</td>
<td>15</td>
<td>121.00</td>
</tr>
</tbody>
</table>

Source: a/ National Fertiliser Development Centre (1982).
       b/ Federal Directorate of Fertiliser Imports, Lahore.
Table 2: SUBSIDY ON FERTILIZERS, 1972-73 TO 1983-84

<table>
<thead>
<tr>
<th>Year</th>
<th>Rupees million</th>
</tr>
</thead>
<tbody>
<tr>
<td>1972-73</td>
<td>103</td>
</tr>
<tr>
<td>1973-74</td>
<td>113</td>
</tr>
<tr>
<td>1974-75</td>
<td>326</td>
</tr>
<tr>
<td>1975-76</td>
<td>601</td>
</tr>
<tr>
<td>1976-77</td>
<td>132</td>
</tr>
<tr>
<td>1977-78</td>
<td>615</td>
</tr>
<tr>
<td>1978-79</td>
<td>1,692</td>
</tr>
<tr>
<td>1979-80</td>
<td>2,455</td>
</tr>
<tr>
<td>1980-81</td>
<td>2,448</td>
</tr>
<tr>
<td>1981-82</td>
<td>1,750</td>
</tr>
<tr>
<td>1982-83</td>
<td>1,948</td>
</tr>
<tr>
<td>1983-84 (budgeted)</td>
<td>1,720</td>
</tr>
</tbody>
</table>

Source: Ministry of Food, Agriculture and Cooperatives, Islamabad.

The National Agricultural Policy of February 1980 called for a progressive reduction in the fertilizer subsidy, with a view to its complete elimination by mid-1985. Achieving this policy goal while still providing adequate incentives for fertilizer use required careful adjustment of agricultural commodity prices.

Rationalizing Agricultural Pricing Policy. With the passage of time, it became increasingly clear that designing and implementing balanced agricultural pricing policies were very complex tasks and required a more systematic approach. In March 1981, the Government therefore created an Agricultural Prices Commission, affiliated with the Federal Ministry of Food, Agriculture and Cooperatives. A professional body, the commission was made autonomous to give it maximum freedom and to insulate it from the pressures of interest groups. It was mandated periodically to study and recommend agricultural pricing policies. Its major task was, and still is, to advise the Government on price policies for the major agricultural crops such as wheat, rice, cotton and sugarcane, and for farm inputs such as fertilizers, pesticides and seeds. It is also required to oversee the implementation of the support price policies and to suggest measures for better implementation.

Since the establishment of the commission, the prices of agricultural commodities have been determined on a more rational basis, taking into account the cost of crop production and the need to: (1) provide incentives to growers to raise productivity and output through improved technology; (2) avoid waste of inputs; and (3) develop production and cropping patterns broadly in line with national requirements. In making price policy recommendations, the commission has also had to assess their impact on the national economy. (The fixed support prices for major crops during the period 1970-71 to 1982-83 are given in Table 3.)
**Table 3: PROCUREMENT/SUPPORT PRICES OF MAJOR CROPS, 1970/71 TO 1983/84**  
(Rs. per 40 kg.)

<table>
<thead>
<tr>
<th>Year</th>
<th>Wheat</th>
<th>Basmati (FAQ)a/</th>
<th>IRRI (FAQ)a/</th>
<th>Seed cotton (B 557 &amp; F-149)b/</th>
<th>Sugarcane c/</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970-71</td>
<td>18.22</td>
<td>34.30</td>
<td>22.40</td>
<td>2.82</td>
<td></td>
</tr>
<tr>
<td>1971-72</td>
<td>18.22</td>
<td>40.72</td>
<td>22.40</td>
<td>2.65</td>
<td></td>
</tr>
<tr>
<td>1972-73</td>
<td>24.11</td>
<td>51.30</td>
<td>22.24</td>
<td>4.52</td>
<td></td>
</tr>
<tr>
<td>1973-74</td>
<td>27.33</td>
<td>66.45</td>
<td>28.94</td>
<td>4.52</td>
<td></td>
</tr>
<tr>
<td>1974-75</td>
<td>39.65</td>
<td>96.45</td>
<td>42.87</td>
<td>5.60</td>
<td></td>
</tr>
<tr>
<td>1975-76</td>
<td>39.65</td>
<td>96.45</td>
<td>42.87</td>
<td>6.12</td>
<td></td>
</tr>
<tr>
<td>1976-77</td>
<td>39.65</td>
<td>108.80</td>
<td>57.87</td>
<td>144.68</td>
<td></td>
</tr>
<tr>
<td>1977-78</td>
<td>39.65</td>
<td>108.80</td>
<td>49.30</td>
<td>159.68</td>
<td></td>
</tr>
<tr>
<td>1978-79</td>
<td>48.23</td>
<td>117.89</td>
<td>52.51</td>
<td>159.68</td>
<td></td>
</tr>
<tr>
<td>1979-80</td>
<td>50.00</td>
<td>117.89</td>
<td>52.51</td>
<td>159.68</td>
<td></td>
</tr>
<tr>
<td>1980-81</td>
<td>58.00</td>
<td>137.00</td>
<td>63.00</td>
<td>171.00</td>
<td></td>
</tr>
<tr>
<td>1981-82</td>
<td>58.00</td>
<td>150.00</td>
<td>72.50</td>
<td>178.00</td>
<td></td>
</tr>
<tr>
<td>1982-83</td>
<td>64.00</td>
<td>154.00</td>
<td>80.00</td>
<td>183.00</td>
<td></td>
</tr>
<tr>
<td>1983-84</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a/ Fair Average Quality (rice with 40 percent broken).
b/ Varieties chosen are of medium staple length.
c/ Sugarcane support prices differ in each province according to sugar recovery. Prices shown here are average prices for the three provinces.

**Source:** Ministry of Food, Agriculture and Cooperatives (1982).

**Countering the Drop in Fertilizer Use.** Because of the above-mentioned measures, fertilizer sales prices have risen quite frequently in the past few years. Overall, they rose by about 47 percent in February 1980, about 15 percent in October 1982 and 10 percent in June 1983. The cumulative increase from February 1980 to June 1983 was about 110 percent. The support prices for farm commodities were also revised upward during this period, with a view, in part, to maintaining a reasonably balanced relationship between the prices of agricultural inputs (particularly fertilizers) and the prices of commodities.

The increases in commodity prices could not wholly neutralize the increase in fertilizer prices. As a result, fertilizer use rose only marginally between 1980-81 and 1981-82 over the level in 1979-80. However, during 1982-83 it went up by 15 percent to 1.24 million nutrient tons (versus 1.04 million nutrient tons in 1979-80). In the first five months (July to November) of fiscal 1983-84, on the other hand, fertilizer consumption declined by about 3 percent as compared with the consumption for the corresponding period of 1982-83 (see Table 1).
To understand the economics of fertilizer use resulting from the changes in fertilizer and agricultural commodity prices over the years, the parity ratio between fertilizer and wheat support prices was worked out for the period 1972-73 to 1982-83 (Table 4). From October 1978 to February 1980, the parity ratio between wheat and fertilizer prices favored wheat (2.2-2.3 units of wheat were needed to buy one unit of nitrogen, 1.5-1.57 units of wheat to buy one unit of phosphorus). However, it became less favorable to wheat as fertilizer prices rose. By June 1983, 3.5 and 2.6 units of wheat were required to purchase one unit of nitrogen and one unit of phosphorus, respectively. Thus, fertilizer prices increased faster than did those of agricultural commodities since February 1980. Similarly, as mentioned earlier, the value-cost ratio decreased over time: for wheat, it went from 3.2:1 in 1979-80 to 2.1:1 in 1983-84. The benefit-cost ratio\(^1\) of fertilizer use also declined—from a level of 2.1:1 in 1979-80 to 1.6:1 in 1983-84, against the ratio of 2:1 considered conducive for promoting fertilizer use in developing countries (Table 5).

Table 4: 
PARITY RATIO BETWEEN WHEAT AND FERTILIZER PRICES, 1972-83 (Rupees)

<table>
<thead>
<tr>
<th>Effective date of change in fertilizer prices</th>
<th>Fertilizer prices per nutrient-ton</th>
<th>Wheat support price per ton</th>
<th>Unit of wheat needed to buy one unit of fertilizer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>P\textsubscript{205}</td>
<td>N</td>
</tr>
<tr>
<td>9/25/72</td>
<td>1,522</td>
<td>1,056</td>
<td>603</td>
</tr>
<tr>
<td>3/30/73</td>
<td>1,826</td>
<td>1,222</td>
<td>603</td>
</tr>
<tr>
<td>8/11/73</td>
<td>2,391</td>
<td>1,667</td>
<td>683</td>
</tr>
<tr>
<td>4/20/74</td>
<td>3,261</td>
<td>2,444</td>
<td>683</td>
</tr>
<tr>
<td>12/19/74</td>
<td>2,853</td>
<td>2,139</td>
<td>991</td>
</tr>
<tr>
<td>2/1/75</td>
<td>3,261</td>
<td>2,444</td>
<td>991</td>
</tr>
<tr>
<td>4/16/76</td>
<td>2,957</td>
<td>2,000</td>
<td>991</td>
</tr>
<tr>
<td>10/17/78</td>
<td>2,739</td>
<td>1,889</td>
<td>1,206</td>
</tr>
<tr>
<td>1979-80</td>
<td>2,739</td>
<td>1,889</td>
<td>1,250</td>
</tr>
<tr>
<td>2/25/80</td>
<td>4,044</td>
<td>2,778</td>
<td>1,250</td>
</tr>
<tr>
<td>3/15/82</td>
<td>4,478</td>
<td>2,778</td>
<td>1,450</td>
</tr>
<tr>
<td>10/6/82</td>
<td>5,130</td>
<td>3,222</td>
<td>1,600</td>
</tr>
<tr>
<td>6/11/83</td>
<td>5,565</td>
<td>4,111</td>
<td>1,600</td>
</tr>
</tbody>
</table>

Note: The prices of urea and SSP were used to work out the nutrient-ton cost for nitrogen and phosphorus, respectively.

Source: Ministry of Food, Agriculture and Cooperatives.

\(^1\) In addition to the direct cost of fertilizers, the benefit-cost ratio also takes into account other relevant costs (e.g., transportation, handling and application costs; harvesting, threshing and marketing costs of the additional grains produced from increased fertilizer use; and interest on fertilizer credit).
Table 5: VALUE-COST RATIO (VCR) AND BENEFIT-COST RATIO (BCR) OF FERTILIZER USE ON WHEAT, 1972-73 TO 1983-84 (Rs. per kg.)

<table>
<thead>
<tr>
<th>Year</th>
<th>Average nutrient price a/</th>
<th>Wheat price</th>
<th>Value-cost ratio (VCR)b/</th>
<th>Benefit-cost ratio (BCR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1972-73</td>
<td>1.48</td>
<td>0.603</td>
<td>2.35</td>
<td>2.08</td>
</tr>
<tr>
<td>1973-74</td>
<td>2.25</td>
<td>0.683</td>
<td>2.12</td>
<td>1.67</td>
</tr>
<tr>
<td>1974-75</td>
<td>3.03</td>
<td>0.991</td>
<td>2.29</td>
<td>1.84</td>
</tr>
<tr>
<td>1975-76</td>
<td>2.96</td>
<td>0.991</td>
<td>2.34</td>
<td>1.58</td>
</tr>
<tr>
<td>1976-77</td>
<td>2.73</td>
<td>0.991</td>
<td>2.54</td>
<td>1.67</td>
</tr>
<tr>
<td>1977-78</td>
<td>2.69</td>
<td>0.991</td>
<td>2.58</td>
<td>1.69</td>
</tr>
<tr>
<td>1978-79</td>
<td>2.55</td>
<td>1.205</td>
<td>3.31</td>
<td>2.09</td>
</tr>
<tr>
<td>1979-80</td>
<td>2.72</td>
<td>1.250</td>
<td>3.22</td>
<td>2.07</td>
</tr>
<tr>
<td>1980-81</td>
<td>3.73</td>
<td>1.450</td>
<td>2.72</td>
<td>1.90</td>
</tr>
<tr>
<td>1981-82</td>
<td>3.77</td>
<td>1.450</td>
<td>2.69</td>
<td>1.89</td>
</tr>
<tr>
<td>1982-83</td>
<td>4.57</td>
<td>1.600</td>
<td>2.45</td>
<td>1.78</td>
</tr>
<tr>
<td>1983-84</td>
<td>5.27</td>
<td>1.600</td>
<td>2.12</td>
<td>1.60</td>
</tr>
</tbody>
</table>

a/ Represents the weighted average price for NPK fertilizer for the financial year.

b/ Taking a grain nutrient ratio of 1:7, the increase in the price of wheat would be 0.603 x 7 = 4.221; the VCR would be 4.221 + 1.48 = 2.85.

Note: VCR = Ratio between the value of the produce obtained from one unit of nutrient of fertilizer and the cost of the fertilizer.

BCR = Ratio between the direct plus indirect costs of the fertilizer to the value of the additional produce (both grain and bhusa).

Source: Ministry of Food, Agriculture and Cooperatives.

III. DETERMINING PRODUCER (EX-FACTORY) FERTILIZER PRICES

At present, Pakistan has an annual installed capacity of over 1 million tons of nitrogen and about 90,000 tons of phosphorus. Actual production runs at about 95 percent of rated capacity on the average (Table 6). The viability of the plants depends mainly on the price at which their end-products are sold in the market.

Setting the prices of the end-products of fertilizer plants calls for full knowledge of the different cost components of production and distribution and the calculation of a fair return. In general, ex-factory prices are set at a level that allows each manufacturer a fair return on invested capital. Existing domestic fertilizer producers, both in the public and private sectors, market their own products, plus some imported fertilizers; they have been allowed producer prices that yield after-tax profits ranging from 15 percent to 20 percent on equity at 90 percent capacity utilization. More specifically:
Table 6: CAPACITY UTILIZATION OF DIFFERENT FERTILIZER PLANTS IN PAKISTAN

<table>
<thead>
<tr>
<th>Start-up year</th>
<th>Name of factory</th>
<th>Product</th>
<th>Nutrient (%)</th>
<th>Production capacity a/ (t)</th>
<th>Actual production b/ in 1982-83 ('000 tons)</th>
<th>Capacity utilization (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>N</td>
<td>P2O5</td>
<td>N</td>
<td>P2O5</td>
</tr>
<tr>
<td>1968</td>
<td>EXXON at Daharki</td>
<td>Urea</td>
<td>46</td>
<td>-</td>
<td>78</td>
<td>-</td>
</tr>
<tr>
<td>1970</td>
<td>Dawood Hercules at Chickoki Mallian</td>
<td>Urea</td>
<td>46</td>
<td>-</td>
<td>160</td>
<td>-</td>
</tr>
<tr>
<td>1958</td>
<td>Pak-American at Iskandarabad</td>
<td>Ammonium sulphate</td>
<td>21</td>
<td>-</td>
<td>19</td>
<td>-</td>
</tr>
<tr>
<td>1979</td>
<td>Pak-Arab at Multan</td>
<td>(1) Calcium ammonium nitrate</td>
<td>26</td>
<td>-</td>
<td>119</td>
<td>-</td>
</tr>
<tr>
<td>1962</td>
<td>Pak-Arab at Multan</td>
<td>(ii) Urea</td>
<td>46</td>
<td>-</td>
<td>33</td>
<td>-</td>
</tr>
<tr>
<td>1979</td>
<td>Pak-Arab at Multan</td>
<td>(iii) Nitro-phosphate</td>
<td>23</td>
<td>23</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>1980</td>
<td>Pak-Saudi at Mirpur Mathelo</td>
<td>Urea</td>
<td>46</td>
<td>-</td>
<td>258</td>
<td>-</td>
</tr>
<tr>
<td>1982</td>
<td>Hazara at Haripur</td>
<td>Urea</td>
<td>46</td>
<td>-</td>
<td>45</td>
<td>-</td>
</tr>
<tr>
<td>1982</td>
<td>Fauji at Sadiqabad</td>
<td>Urea</td>
<td>46</td>
<td>-</td>
<td>262</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Lyallpur Chemical and Fertilizer Ltd.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1957</td>
<td>(i) At Faisalabad</td>
<td>Single super phosphate</td>
<td>-</td>
<td>18</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>1976</td>
<td>(ii) At Jaranwala</td>
<td>Single super phosphate</td>
<td>-</td>
<td>18</td>
<td>-</td>
<td>15</td>
</tr>
<tr>
<td>1982</td>
<td>(iii) Pak Steel Mills Ltd, Karachi</td>
<td>Ammonium sulphate</td>
<td>21</td>
<td>-</td>
<td>NA</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: a/ National Fertiliser Development Centre, Planning and Development Division, Islamabad.

b/ Federal Directorate of Fertiliser Imports, Lahore.
- ESSO (EXXON), which built the first modern fertilizer plant in Pakistan, is allowed factory-gate prices that are linked to international price levels.

- Dawood Hercules (DH) has an agreement which stipulates that ex-factory prices be tied to a satisfactory level of profitability.

- Pak-Arab is allowed a 15 percent after-tax return on equity, provided plant output reaches at least 90 percent of designed capacity.

- Pak-Saudi is allowed a 15 percent return on share capital at 100 percent capacity utilization for 320 days a year.

- Fauji has an agreement reached in 1978 that calls for a 20 percent after-tax return on initial common (and 16 percent on preferred) share capital, based respectively on 65 percent, 85 percent and 90 percent capacity utilization in the first, second and third years of operation and on the basis of 315 annual operating days.

The ex-factory costs are verified by the Ministry of Industries after a review of the companies' audit reports.

Distribution and Marketing

With the creation of adequate domestic production capacity, the local manufacturers, who are mainly nitrogenous fertilizer producers, have been allowed to sell their products through their own network of dealers. They are also allowed to distribute a part of the imported fertilizers, mostly phosphatic and potassic, to promote balanced fertilizer use. In addition, the Provincial Governments have their own organizations for marketing fertilizers.

The marketing margins allowed to fertilizer distributors have evolved on the basis of actual experience and differ from factory to factory (Table 7) depending on factors such as location, production volume, organizational set-up, storage/warehouse facilities and sales promotion campaign. The main elements in calculating the marketing margin are:

- **Freight charges:** They represent the largest single distribution cost component. Except for Dawood-Hercules, where these charges are fixed, reimbursement is on the basis of expenditures.

- **Dealers' commission:** It provides an incentive to sales agents to act as a link with the farming community, with the commission related to the amount and period of the dealers' investment. In addition, dealers are often given promotional incentives to encourage the use of certain types of fertilizers during periods of low off-take. The
Table 7: MARKETING INCIDENTALS FOR DOMESTIC FERTILIZERS, 1981-82

<table>
<thead>
<tr>
<th>Cost component</th>
<th>1982 DH</th>
<th>1982 EXXON</th>
<th>Urea Pak-Arab</th>
<th>Urea Pak-Saudi</th>
<th>Urea Hazara</th>
<th>AS Pak-American</th>
<th>CAN Pak-Arab</th>
<th>SSP Lyallpur</th>
<th>NP Pak-Arab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mark-up</td>
<td>28</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Organization and administration</td>
<td>19</td>
<td>74</td>
<td>29</td>
<td>13.06</td>
<td>13.06</td>
<td>13.06</td>
<td>13.06</td>
<td>13.06</td>
<td>13.06</td>
</tr>
<tr>
<td>Handling at railhead</td>
<td>12</td>
<td>-</td>
<td>32</td>
<td>2.96</td>
<td>2.96</td>
<td>2.96</td>
<td>2.96</td>
<td>2.96</td>
<td>2.96</td>
</tr>
<tr>
<td>Handling from railhead to non-mandi town</td>
<td>-</td>
<td>135</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Freight</td>
<td>80</td>
<td>-</td>
<td>146</td>
<td>69.43</td>
<td>173.74</td>
<td>97.02</td>
<td>134.38</td>
<td>128.58</td>
<td>86.81</td>
</tr>
<tr>
<td>Storage</td>
<td>-</td>
<td>-</td>
<td>33</td>
<td>12.76</td>
<td>12.76</td>
<td>-</td>
<td>-</td>
<td>12.76</td>
<td>-</td>
</tr>
<tr>
<td>Dealer commission and allowance</td>
<td>50</td>
<td>50</td>
<td>59</td>
<td>78.54</td>
<td>82.86</td>
<td>43.98</td>
<td>51.23</td>
<td>67.44</td>
<td>63.81</td>
</tr>
<tr>
<td>Sales promotion</td>
<td>-</td>
<td>-</td>
<td>15</td>
<td>4.71</td>
<td>4.71</td>
<td>4.71</td>
<td>4.71</td>
<td>4.71</td>
<td>4.71</td>
</tr>
<tr>
<td>(Less) other income</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>(11.95)</td>
<td>(14.56)</td>
<td>(1.23)</td>
<td>(3.10)</td>
<td>(6.45)</td>
<td>(5.46)</td>
</tr>
<tr>
<td>Total</td>
<td>181</td>
<td>287</td>
<td>320</td>
<td>195.81</td>
<td>301.83</td>
<td>186.80</td>
<td>229.54</td>
<td>249.36</td>
<td>192.19</td>
</tr>
</tbody>
</table>

--- Rupees/ton ---

* DH: Dawood Hercules fertilizer factory.
* EXXON: ESSO fertilizer factory.
* FFC: Fauji fertilizer company.

Source: Prices and Supply Wing, Ministry of Industries, Islamabad.
commission varies from firm to firm within a range of 36 to 59 percent of total marketing costs (Table 7). Other costs include financing charges, storage and sales promotion.

- **Storage costs:** Each fertilizer firm is required to maintain adequate storage to meet the seasonal needs of the market, with the capacity dependent on location and the volume to be distributed. Based on actual experience with indigenous production and consumption, manufacturers must also maintain reserve stocks, which differ for each fertilizer factory depending on the type and quantity of fertilizer produced and stored before sales. The general requirement is for a storage capacity equivalent to one-and-a-half months of production capacity.

- **Interest/financial costs:** These costs are incurred in connection with inventory building and related credit financing. They differ among factories.

- **Organizational and sales promotion costs:** These expenditures are related to a factory's marketing strategy, including the volume and product mix to be distributed. These costs vary from 4.3 percent to 25.8 percent of the total marketing cost of the factories.

The distribution costs for incidentals or overhead allowed for domestic production ranged between Rs. 181 and Rs. 393 a ton in 1982-83. The possibility of reducing this wide variation is being investigated by a committee in the Ministry of Food, Agriculture and Cooperatives. The incidentals allowed for imported fertilizers ranged between Rs. 647 and Rs. 743 a ton during the same period. They were higher for imported fertilizers because they included wharfage, clearing and forwarding charges, freight charges from the port to the main stores, and interest (for four months) on credit for the purchase and handling of fertilizers.

**Retail Prices**

With respect to retail fertilizer prices, the Government's policy is to fix a uniform sales price to farmers for each fertilizer product throughout the country at a level that encourages farmers to consume more fertilizers. If there is a difference between the ex-factory cost/c.i.f. import cost (plus specified transportation and distribution costs) and the sales price of fertilizers to farmers, the Government covers it by subsidy payments. However, in some cases, particularly where fertilizer plants were established many years ago (such as Dawood-Hercules), the ex-factory price plus specified transportation and distribution costs remains well below the sale price. In such instances, the Government collects a surcharge equivalent to the difference to preclude an excessive rate of return.
The Government also uses the pricing structure to promote balanced use of different fertilizers. This policy is necessitated by the present low use of phosphatic fertilizers and almost negligible use of potash. Thus, except for the initial years of fertilizer use, the sale price of nitrogen (e.g., in urea) has always been the highest, followed by phosphorus (e.g., in single super phosphates) and potash (e.g., in sulphate of potash). The cumulative annual increase in prices from 1966 to mid-1983 has also been the highest for nitrogen (about 10 percent) as compared with phosphorus (8.5 percent) and potash (4.7 percent).

Domestic vs. Import Prices

Pakistan, being rich in natural gas, the main raw material used at present to produce nitrogenous fertilizers, has been able to produce urea (the leading nitrogenous fertilizer) at a competitive cost. In spite of the high capital costs of two recently installed fertilizer plants, Pak-Saudi and Pak-Arab, the ex-factory cost of urea ranged between Rs. 1,617 and Rs. 2,024 a ton during 1981-82, as compared with the average c.i.f. cost of Rs. 2,265 a ton for imported fertilizers. (The cost of production at Pak-Saudi and Pak-Arab, along with their ex-factory prices, are given in Tables 8 and 9). The ex-factory costs of the older plants are 50-100 percent lower. (For purposes of comparison, the cost of production at Dawood Hercules, a urea plant established in 1970, is given in Table 10.)

IV. OPTIONS FOR THE FUTURE: NON-PRICE MEASURES

There does not seem to be much scope in the near future for offsetting the adverse effects of the increases in fertilizer prices by adjusting the support prices for agricultural commodities: the support prices have been rising continually, particularly in recent years, and at present, the support prices of cotton and wheat are already close to the export parity price, while those of rice and sugar are even higher.
Table 8: COST OF PRODUCTION OF UREA AT PAK-SAUDI FERTILIZER FACTORY AT MIRPUR MATHELO a/  

<table>
<thead>
<tr>
<th></th>
<th>1981-82</th>
<th></th>
<th>1980-81</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total cost</td>
<td>Cost per</td>
<td>Total cost</td>
<td>Cost per</td>
</tr>
<tr>
<td></td>
<td>(Rs. million)</td>
<td>ton (Rs.)</td>
<td>(Rs. million)</td>
<td>ton (Rs.)</td>
</tr>
<tr>
<td>I. Variable costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas as feedstock</td>
<td>38.85</td>
<td>77.40</td>
<td>84.84</td>
<td></td>
</tr>
<tr>
<td>Gas as fuel</td>
<td>52.34</td>
<td>104.27</td>
<td>116.37</td>
<td></td>
</tr>
<tr>
<td>Canal water</td>
<td>0.25</td>
<td>0.50</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Chemical and catalysts</td>
<td>11.60</td>
<td>23.11</td>
<td>32.63</td>
<td></td>
</tr>
<tr>
<td>Packing material</td>
<td>67.18</td>
<td>133.86</td>
<td>112.07</td>
<td></td>
</tr>
<tr>
<td>Other expenses (allocated)</td>
<td>4.10</td>
<td>8.18</td>
<td>8.42</td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>174.32</td>
<td>347.32</td>
<td>354.38</td>
<td></td>
</tr>
<tr>
<td>II. Fixed cost less income on intermediate products b/</td>
<td>383.98</td>
<td>833.63</td>
<td>1,018.06</td>
<td></td>
</tr>
<tr>
<td>Total (I and II)</td>
<td>558.30</td>
<td>1,182.95</td>
<td>1,372.44</td>
<td></td>
</tr>
<tr>
<td>III. Return on equity</td>
<td>199.45</td>
<td>432.02</td>
<td>503.95</td>
<td></td>
</tr>
<tr>
<td>IV. Ex-factory cost</td>
<td>757.75</td>
<td>1,616.97</td>
<td>1,876.30</td>
<td></td>
</tr>
<tr>
<td>V. Return on equity as percent of ex-factory cost</td>
<td></td>
<td></td>
<td>27 percent</td>
<td></td>
</tr>
</tbody>
</table>

a/ Annual rated capacity of the plant is 285,000 tons of nitrogen.

b/ Fixed cost includes salaries, wages, maintenance of stores, depreciation and other administrative expenditures.

Source: Prices and Supply Wing, Ministry of Industries, Islamabad.
Table 9: COST OF PRODUCTION OF UREA AT PAK-SAUDI FERTILIZER
FACTORY AT MULTAN a/

<table>
<thead>
<tr>
<th></th>
<th>1981-82</th>
<th>1980-81</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total cost (Rs. million)</td>
<td>Cost per ton (Rs.)</td>
</tr>
<tr>
<td>I. Variable costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance of stores</td>
<td>1.59</td>
<td>32.78</td>
</tr>
<tr>
<td>Spares consumed</td>
<td>2.84</td>
<td>39.95</td>
</tr>
<tr>
<td>Hired labor</td>
<td>0.10</td>
<td>0.33</td>
</tr>
<tr>
<td>Electricity duty</td>
<td>0.39</td>
<td>10.47</td>
</tr>
<tr>
<td>Allocated cost</td>
<td>13.25</td>
<td>241.42</td>
</tr>
<tr>
<td>Ammonia</td>
<td>21.77</td>
<td>411.61</td>
</tr>
<tr>
<td>Anitrates solution</td>
<td>0.16</td>
<td>2.61</td>
</tr>
<tr>
<td>Bagging and packing</td>
<td>7.09</td>
<td>126.07</td>
</tr>
<tr>
<td>Subtotal</td>
<td>47.19</td>
<td>865.24</td>
</tr>
<tr>
<td>II. Fixed costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salaries, wages and other</td>
<td>4.38</td>
<td>58.99</td>
</tr>
<tr>
<td>Administrative expenditures</td>
<td>8.37</td>
<td>173.27</td>
</tr>
<tr>
<td>Allocated costs</td>
<td>16.48</td>
<td>315.92</td>
</tr>
<tr>
<td>Ammonia</td>
<td>0.15</td>
<td>2.65</td>
</tr>
<tr>
<td>Anitrates solution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subtotal</td>
<td>29.38</td>
<td>550.83</td>
</tr>
<tr>
<td>III. Expenditures on general administration plus interest less income from intermediate products</td>
<td>10.04</td>
<td>302.51</td>
</tr>
<tr>
<td>Grand total (I + II + III)</td>
<td>86.61</td>
<td>1,718.58</td>
</tr>
<tr>
<td>IV. Ex-factory cost</td>
<td>101.65</td>
<td>2,023.78</td>
</tr>
</tbody>
</table>

a/ Annual rated capacity of the plant is 33,000 tons of nitrogen.

Source: Prices and Supply Wing, Ministry of Industries, Islamabad.
Table 10: COST OF PRODUCTION OF DAWOOD HERCULES UREA PLANT AT CHICKOKI MALLIAN \(\text{a/}\)

<table>
<thead>
<tr>
<th></th>
<th>1980</th>
<th>1979</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Rs. million)</td>
<td>Cost per ton (Rs.)</td>
</tr>
<tr>
<td>I. Variable costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas</td>
<td>114.93</td>
<td>310.85</td>
</tr>
<tr>
<td>Chemicals and acids</td>
<td>7.54</td>
<td>20.40</td>
</tr>
<tr>
<td>Power</td>
<td>1.16</td>
<td>3.14</td>
</tr>
<tr>
<td>Containers</td>
<td>41.81</td>
<td>113.10</td>
</tr>
<tr>
<td>Contract labor</td>
<td>4.14</td>
<td>11.19</td>
</tr>
<tr>
<td>Stores, spares and maintenance</td>
<td>5.25</td>
<td>14.19</td>
</tr>
<tr>
<td>Subtotal (I)</td>
<td>174.83</td>
<td>472.87</td>
</tr>
<tr>
<td>II. Fixed costs</td>
<td>135.21</td>
<td>391.92</td>
</tr>
<tr>
<td>Labor, salary, administration and taxes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>III. Return on equity</td>
<td>-</td>
<td>144.41</td>
</tr>
<tr>
<td>IV. Ex-factory cost (I + II + III)</td>
<td>-</td>
<td>1,009.2</td>
</tr>
<tr>
<td>V. Return on equity as percent of ex-factory cost</td>
<td></td>
<td>14</td>
</tr>
</tbody>
</table>

\(\text{a/}\) Annual rated capacity of the plant is 160,000 tons of nitrogen.

Source: Prices and Supply Wing, Ministry of Industries, Islamabad.
Examining the Options

The data in Table 2 show that the recent increases in fertilizer sales prices have reduced the Government's subsidy bill by about 30 percent, from a level of Rs. 2,455 million in 1979-80 to about Rs. 1,720 million in 1983-84. To achieve the goal of eliminating the fertilizer subsidy by mid-1985 without adversely affecting fertilizer use and agricultural production, in May 1982 the Federal Planning and Development Division set up a Standing Committee on Fertiliser, headed by the Chairman of the Agricultural Prices Commission. The committee considered in detail the implications of eliminating the fertilizer subsidy and what constituted the subsidy, e.g., what were its main components. The committee made some important suggestions, for example, about defining the subsidy. These are summarized below:

1. The fertilizer subsidy should be worked out on a "net" instead of a "gross" basis, so that the "development surcharge" is accounted for.

2. The subsidy should be worked out on the off-take target for a given year rather than on the quantity actually produced, procured or imported.

3. Since the fertilizers imported under external aid/credit or barter are substantially more expensive than those imported against cash, the subsidy costs of the former are correspondingly higher. Further study is needed to quantify the price differentials of fertilizers purchased under the various arrangements to facilitate any policy decision.

4. Wherever possible, fertilizers should be transported by rail rather than road, which is at present 160 percent costlier. Further, separate allocations should be made for transport charges to depressed and remote areas, since these costs are far higher and distort the overall picture of incidental charges, thereby affecting the extent of the subsidy.

5. The required amount of reserve stocks, the subsidy for which is also included in the subsidy bill, should be re-examined, as present levels are considered unduly high and add substantially to the bill.

The committee's recommendations are being reviewed. Meanwhile, the Government has already decided to include the fertilizer subsidy in the next year's budget on a "net" rather than "gross" basis. Since they estimated surcharge stemming from the relatively low-cost production of some domestic fertilizer plants constitutes about 25 percent of the gross subsidy outlay, the subsidy bill is likely to be reduced to that extent. If other recommendations of the committee are implemented, they, too, will lead to a substantial reduction in the subsidy.
Non-Price Measures

As noted, eliminating the subsidy on fertilizers remains the ultimate goal. Doing so requires concerted efforts to improve the efficiency of fertilizer use and the economics of crop production by improving productivity. As such, non-price measures such as achieving a favorable value-cost ratio and benefit-cost ratio in order to maintain the desired increases in fertilizer consumption have become more important. A study entitled "Impact of Fertilizer Pricing on Fertilizer Use in Pakistan," issued recently by the National Fertiliser Development Centre, noted the importance of additional measures, such as better water availability, marketing improvements and greater literacy among farmers, and improved effectiveness of extension services, research and information dissemination. The study concluded that except for marketing improvements, the other measures have a relatively long lead time.

Certain non-price measures discussed below need particular attention:

- **Agricultural extension services.** Research stations for cereal crops in Pakistan have attained grain-nutrient ratios as high as 14:1. By contrast, experts estimate that the grain-nutrient ratio on the farmer's field in Pakistan averages only 7:1. This indicates substantial scope for increasing yields through fertilizers.

  Pakistan has reached a fairly sophisticated stage of fertilizer use that requires even more vigorous and effective agricultural extension work. Farmers need to be convinced, based on profitability, to use fertilizers in optimal and balanced doses. In turn, this means the dissemination of reliable information on different aspects of fertilizers, such as the status of fertilizer use, field-specific recommendations, computed optimal fertilizer dosages by crop, the cost-benefit aspects of fertilizer use, and so on. A system should be evolved whereby extension workers carry out extensive fertilizer demonstrations under the guidance of technical specialists on a regular basis.

  Before the use of balanced fertilizers can be advocated, the availability of various nutrients in the soil needs to be determined. Soil testing laboratories for this purpose are now being set up at the district level and, in some provinces, at the tehsil level. However, the soil testing service requires strengthening.

- **Credit.** Availability of credit plays an important role in increasing a farmer's acceptance of high-priced fertilizers. Small farmers in particular find it difficult to pay cash for fertilizers. Increases in the support prices for agricultural commodities do not ease their credit needs sufficiently, since the marketable surplus, especially
of wheat (half of all fertilizer is applied to the wheat crop), is rather small. The flow of credit needs to be sufficient to cover increases in fertilizer use and prices.

As to credit sources, according to a survey conducted in 1980 by the National Fertiliser Development Centre, only large farmers benefit from institutional credit, whereas small- and medium-size farmers get their credit mostly from non-institutional sources. Further, 52 percent of the farmers using credit received insufficient amounts for fertilizer purchases. Of the non-users of production credit, 46 percent reported the inaccessibility of institutional credit as the main reason.

The Federal Bank for Cooperatives, the commercial banks and the Agricultural Development Bank of Pakistan are now extending institutional credit to farmers under a multi-agency system designed to meet the needs of farmers, particularly in the poorer rural areas. Further, there has been a rapid increase in the provision of interest-free credit for small farmers (generally those owning land up to 12.5 acres). A large expansion of institutional credit took place in 1979-80 (64 percent) and in 1980-81 (56 percent). Nevertheless, institutional credit has been meeting only 26 percent of the total credit requirements of farmers. With the continuous increase in the use of fertilizer and other inputs, and the rise in their prices, much larger supplies of credit are required.

Marketing. When domestic production of fertilizers was below demand and there was greater dependence on imports, consumers faced serious shortages in supplies, mainly for two reasons. First, the foreign exchange required for imports was hard to obtain. Second, the period between the time the order was placed and the fertilizer was imported and made available to farmers was long, sometimes 9-12 months.

With the emerging surplus, especially in nitrogenous fertilizers, distribution and marketing have now become particularly important in promoting increased fertilizer use. A major obstacle to fertilizer use by many small-scale farmers especially in remote, backward and unirrigated areas still appears to be shortages in supplies because of inadequate marketing arrangements. Marketing deficiencies need to be identified precisely so that more effective remedial measures can be taken.
V. SUMMARY AND CONCLUSIONS

Fertilizer use in Pakistan rose at an average rate of 21 percent a year between 1955 and 1983. This increase in consumption resulted from a number of policy measures the Government took. They included the granting of substantial fertilizer subsidies to farmers, ensuring the availability of fertilizers through a well-planned import program, improving the marketing system (in part by relying on the private sector and by setting up a network of fertilizer retail outlets throughout the country), and adjusting agricultural commodity prices in light of the rising prices of fertilizers and other agricultural inputs. In addition, a soil-testing program to determine the nutrient status of soils was initiated nationally.

The combination of higher fertilizer use and the hike in fertilizer prices caused the Government's subsidy bill to increase considerably over time, restricting the availability of resources for other development programs, even of high priority. The Government therefore modified its earlier policy and, during the past three years, raised the prices of fertilizers by about 110 percent. Immediately after the first steep rise in fertilizer prices in February 1980, the growth in fertilizer use dropped to zero. Subsequently, increases in the support prices for major agricultural commodities helped boost fertilizer off-take once again. During the the Sixth Five-Year Plan (1983-88), it is expected that fertilizer use will increase by about 10 percent a year.

Even though fertilizer prices to farmers have been increased in recent years, the Government's subsidy bill is still high, accounting for about 30 percent of the actual cost of fertilizers. The 1983-84 budget provides Rs. 1,720 million as a fertilizer subsidy. There are, however, anomalies in the definition of the subsidy, a question that was studied by a Standing Committee. If the definition of the subsidy is modified as recommended by the committee, the subsidy in 1983-84 will be around 20 percent lower.

The policy of the Government has been to review agricultural commodity prices from time to time in light of increases in fertilizer and other input prices. The Agricultural Prices Commission has recommended raising the support prices of major agricultural commodities gradually where necessary. However, in practice the magnitude of the increase has been such that the prices of some crops have exceeded international levels, while others are nearing them. It is obvious that the Government cannot continue this policy of increasing the support prices for agricultural commodities indefinitely, particularly for those crops that have an export potential.

The logical approach is to identify non-price measures that can help improve production efficiency and improve the crop-response ratio, thereby lowering production costs. To achieve this objective, the efficiency of land, water and fertilizer use has to be enhanced. More balanced fertilizers have to be used in combination with organic matter.
When the considerable data already generated by the soil fertility survey are fully analyzed, it should be possible to identify the potential for improved fertilizer use in more precise terms. Meanwhile, further experimentation on fertilizer use is needed to increase its efficiency and the crop-response ratio. The testing of soils to determine precisely the deficiency in terms of different nutrient needs to be conducted on a priority basis. There is a need for more soil testing laboratories to meet the needs of farmers. Concomitantly, training programs for extension workers have to be strengthened, the flow of credit to farmers has to be expanded, and proper marketing infrastructure has to be developed where necessary.
FERTILIZER PRICING IN BRAZIL

Knud H. Schultz, Inter-Ministerial Pricing Committee
and
Jorge A. S. Mattos, Assistant to the Vice President, Petrofertil

I. THE FERTILIZER SECTOR

Structure of the Industry

In the past, because of the lack of dependable and economic feedstocks, Brazil had resorted to imports of fertilizers. However, after experiencing heavy foreign exchange expenditures during 1973-75 when fertilizer import prices hit very high levels, the Government instituted a policy of self-sufficiency in domestic production. A comparison of domestic production and imports of raw materials and fertilizers for the years 1976 and 1983 is given in Figures 1 and 2.

Broadly speaking, Brazil's fertilizer industry today can be categorized as follows:

(1) Privately-owned companies that produce and sell basic and/or intermediate raw materials, basic fertilizers and NPK blends. (There are two large companies and one relatively small one.)

(2) Government-owned companies under PETROFERTIL (within PETROBRAS) that produce and sell basic fertilizers. There are five large companies in this category. These companies do not handle NPK blends or sell directly to farmers. They are the sole producers of nitrogenous materials and manufacture about 90 percent of the nitrogenous fertilizers.

(3) Privately-owned companies that produce and sell basic fertilizers and NPK blends, using raw materials obtained from other companies.

(4) Privately-owned companies or agricultural cooperatives that only sell and distribute basic fertilizers and NPK blends obtained from other companies.

The companies in categories (1) and (3) are located mainly in the mid-south near the coast. These plants go back to the early days of the industry, when Brazil imported practically all its raw materials. Since 1974, however, the trend has been to erect plants in the midwest. The reasons are the discovery of phosphate reserves and the proximity to potentially cultivatable areas. Two other traditional fertilizer centers are near the Santos and Rio Grande harbors.
Figure 1:

BRAZIL
Domestic Production and Imports of Fertilizer Raw Materials and Intermediate Products

Legend:
- Imports
- Total Domestic Production
- Domestic Production by PETROBRAS

<table>
<thead>
<tr>
<th></th>
<th>1976</th>
<th>1983</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHOSPHATE ROCK ($P_2O_5$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imports</td>
<td>111</td>
<td>579</td>
</tr>
<tr>
<td>Total</td>
<td>16</td>
<td>47%</td>
</tr>
<tr>
<td>Production by</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PETROBRAS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>1976</th>
<th>1983</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHOSPHORIC ACID ($P_2O_5$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imports</td>
<td>353</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>169</td>
<td>579</td>
</tr>
<tr>
<td>Production by</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PETROBRAS</td>
<td>33%</td>
<td>70%</td>
</tr>
</tbody>
</table>

Source: PETROFERTIL.

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Figure 2:

BRAZIL
Domestic Production of Fertilizers and Imports

Legend:
- Imports
- Total Domestic Production
- Domestic Production by PETROBRAS

<table>
<thead>
<tr>
<th>Year</th>
<th>Nitrogen</th>
<th>Phosphate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1976</td>
<td>104</td>
<td>382</td>
</tr>
<tr>
<td>1983</td>
<td>628</td>
<td>846</td>
</tr>
</tbody>
</table>

Nitrogen:
- Urea
- Nitrochalk
- Ammonium Nitrate
- Ammonium Sulphate

Phosphate:
- DAP
- MAP
- TSP
- SSP

Source: PETROFERTIL
Production and Capacity

Because of the large amount of capital required to manufacture chemical fertilizers, the private sector has concentrated on importing, mixing, blending and distributing, rather than on establishing large-scale, capital-intensive production facilities. Most companies compete at the retail level, and only a few have their own production facilities.

At the end of 1983, the total capacity of nitrogen was about 1,000,000 tons, and of phosphorous, 1,300,000 tons. Of the nitrogen capacity, about 54 percent (540,000 tons) was produced using natural gas as the feedstock, 14 percent (140,000 tons), refinery gas and the remaining 32 percent, heavy fuel oil (asphaltic residue).

II. CONSUMPTION, MARKET GROWTH AND DEMAND

During the last 10 years, the growth of the fertilizer market passed through two distinct phases. A third is just getting underway with the world economic recovery.

The first phase, from 1973 to 1980, was characterized by an average 14 percent a year increase in fertilizer consumption. This increase was the result of: high international prices for agricultural commodities; and an increase in the speculative demand for raw materials and other inputs caused by the 1973 jump in world oil prices.

In the early 1970s, the worldwide scarcity of food and high rate of inflation forced world commodity prices to move up. These prices spurred the production of export crops and, consequently, also raised the consumption of agricultural inputs, including fertilizers. Consumption of fertilizers per hectare (ha) of arable land and permanent crops in Brazil went from 54.3 kg./ha. during 1974-76 to 82.9 kg./ha. in 1979 for the 14 main crops, which accounted for 90 percent of total arable land.

Because of increased demand and the rising international cost of raw materials, the prices of agricultural inputs also rose. The expectation of still larger increases led farmers to build large inventories of fertilizers as a hedge. The economic environment also led the Brazilian Government to act. The increase in oil prices spurred it to look for alternative energy programs. Simultaneously, the sharp increase in fertilizer demand and the emphasis on improving agriculture productivity led to programs oriented toward the expansion and modernization of the fertilizer industry. To support this, the Government increased the availability of rural credits at low interest rates. The purpose was to expand the land under cultivation and to encourage the use of modern inputs by offering credits at subsidized interest rates. This program did stimulate the demand for fertilizers, and the industry itself had resources to invest in response to that increased demand.
The situation changed from 1981 on, the beginning of the second phase. This period was characterized by a sharp drop (36 percent) in the demand for fertilizers. The main reasons were: (1) the fall in the world prices of agricultural commodities; (2) a lack of rural credits and rising interest rates; and (3) acceleration of inflation and Brazil's increasing internal indebtedness.

Conditions during this second phase produced a policy conflict between the provision of rural credit at subsidized interest rates and the need to reduce the public deficit. Moreover, the excessive increase in internal indebtedness that resulted from the high rates of inflation and the deterioration of commodity prices in the international market were subverting the credit program. In view of the low agricultural prices, farmers anticipated poor returns from their harvests. At the same time, however, they saw they could get higher returns by investing their low interest credits in the financial markets.

Given the high rates of inflation and public deficit, and the way credits were being used, the Government decided to tighten the rural credit program for both investments and production. It required that farmers obtain a larger share of funds from private sources, and it looked more closely at their applications for credits.

These moves resulted in an increase in interest rates for farmers that directly affected fertilizer use. Consumption per hectare of arable land and permanent crops dropped to 63.1 kg. in 1981 for the 14 main crops, which accounted for 90 percent of total arable land. Farmers drew heavily on their inventories, which were exhausted within a year, following which they cut back on the use of nutrients. As such, the market for fertilizers contracted. To prevent a collapse in the agricultural sector in the face of falling commodity prices, the Government established support prices. These prices were modified periodically on the basis of inflation.

This second phase persisted up to 1983, when the current third phase began. It was initiated by the recovery of agricultural commodity prices in the international market and the Government's fight against high inflation. Fertilizer consumption in 1983 reached approximately the same level as in 1976. As the recovery of the international prices for Brazil's traditional agricultural exports, mainly soybeans, continues, there should be even more growth in the demand for fertilizers.

III. FERTILIZER PRICING

Pricing Trends

From 1965 to 1971, as demonstrated in Figure 3 for NPK, the real prices of fertilizers paid by farmers declined gradually. By contrast, during 1971-1974, there were substantial increases. This was particularly true in 1974, when prices nearly doubled over the previous year. This
Figure 3:

NPK Price Evolution Indexes
(1966-1970 = 100)

Source: IEA/CEFER.

World Bank—26510
rise, attributable to the general increase in the costs of imported raw materials, led the Government to establish reference prices—maximum prices for sales to consumers—to avoid excessive prices during the period of rapid increase in fertilizer consumption. The price controls started in September 1975 with NPK blends and were extended in 1977 to basic fertilizers and raw materials. The prices of raw materials, basic fertilizers, and fertilizer blends remained under Government control until December 1980. Periodic readjustments were made on the basis of changes in production costs. In 1981-82, prices were partially freed, with controls remaining only on raw materials. However, in 1983, controls were re-established for the fertilizer sector as a whole.

The Ex-Factory Pricing Mechanisms

At present, the ex-factory prices for locally produced fertilizers are set quarterly by the Government's Interministerial Prices Council using a cost plus system that allows efficient producers an 18.8 percent before tax (equivalent to 12.2 percent after tax) return on investment.

The pricing system takes into account the production costs, fixed assets, and working capital needs of all plants, weighted on the basis of the installed capacity of each unit at 80 percent capacity utilization. Production costs consist of: variable costs—based on standardized consumption coefficients and input prices; fixed costs; and freight from the producer to the consumer. Fixed assets and working capital are determined from accounting statements and the actual cost structure of each plant.

Under the current ex-factory pricing formula, the retail prices paid by farmers vary according to the source of supply. However, the Government makes retail prices roughly equal for the main three regions—South, Center and Northeast.

IV. EVALUATION OF THE SYSTEM

Costs Versus Prices

The evolution of fertilizer and raw material prices during the period 1978/1983 is shown in Table 1. With the exception of sulphuric acid prices, which were strongly affected by the price increases for sulphur, MAP and DAP, all other product prices declined.

Table 2 displays the composition of the prices for raw materials and fertilizers. It shows a disparity between the price fixed by the Government and the price considered adequate, i.e., the price at which the industry would achieve a return on investment of 10-15 percent a year. This is the rate that several international organizations consider reasonable and attractive for companies of this kind. Achieving that rate
Table 1: RAW MATERIAL AND FERTILIZER PRICE INDEX, 1978-84
(1st semester 1978 = 100)

<table>
<thead>
<tr>
<th>Period</th>
<th>Raw materials</th>
<th>Fertilizers</th>
<th>Fertilizers</th>
<th>Blends NPK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ammonia</td>
<td>Phosphate</td>
<td>Sulfuric</td>
<td>Phosphoric</td>
</tr>
<tr>
<td></td>
<td>rock</td>
<td>acid</td>
<td>acid</td>
<td>acid</td>
</tr>
<tr>
<td>1978 1st semester</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>2nd semester</td>
<td>88</td>
<td>102</td>
<td>88</td>
<td>88</td>
</tr>
<tr>
<td>1979 1st semester</td>
<td>84</td>
<td>91</td>
<td>88</td>
<td>87</td>
</tr>
<tr>
<td>2nd semester</td>
<td>95</td>
<td>105</td>
<td>100</td>
<td>98</td>
</tr>
<tr>
<td>1980 1st semester</td>
<td>75</td>
<td>104</td>
<td>150</td>
<td>87</td>
</tr>
<tr>
<td>2nd semester</td>
<td>72</td>
<td>98</td>
<td>167</td>
<td>114</td>
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<td>1981 1st semester</td>
<td>101</td>
<td>100</td>
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</tr>
<tr>
<td>2nd semester</td>
<td>93</td>
<td>106</td>
<td>174</td>
<td>113</td>
</tr>
<tr>
<td>1982 1st semester</td>
<td>87</td>
<td>123</td>
<td>186</td>
<td>119</td>
</tr>
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<td>2nd semester</td>
<td>75</td>
<td>102</td>
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<td>100</td>
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<tr>
<td>1983 1st semester</td>
<td>51</td>
<td>78</td>
<td>189</td>
<td>75</td>
</tr>
<tr>
<td>2nd semester</td>
<td>47</td>
<td>68</td>
<td>147</td>
<td>67</td>
</tr>
<tr>
<td>1984 Jan.-Mar.</td>
<td>55</td>
<td>75</td>
<td>138</td>
<td>81</td>
</tr>
</tbody>
</table>

Notes: Raw materials and fertilizers--semester average. Blends NPK--annual average.
Source: PETROFERTIL; Instituto de Economia Agricola (IEA).
Table 2: BUILD-UP OF COSTS AND PRICES, AVERAGE MARCH 1984 VALUES
(US$/ton, unless otherwise noted)

<table>
<thead>
<tr>
<th>Products</th>
<th>Fixed prices</th>
<th>Production costs</th>
<th>Gross margin</th>
<th>Adequate prices</th>
<th>Increase necessary a/ %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Actual</td>
<td>Adequate</td>
<td></td>
</tr>
<tr>
<td>I. Raw materials (ex-factory)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phosphate rock</td>
<td>38</td>
<td>33</td>
<td>5</td>
<td>21</td>
<td>54</td>
</tr>
<tr>
<td>Ammonia</td>
<td>123</td>
<td>123</td>
<td>-</td>
<td>69</td>
<td>192</td>
</tr>
<tr>
<td>Sulphuric acid</td>
<td>54</td>
<td>57</td>
<td>-3</td>
<td>13</td>
<td>75</td>
</tr>
<tr>
<td>Phosphoric acid</td>
<td>384</td>
<td>414</td>
<td>-</td>
<td>36</td>
<td>450</td>
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<tr>
<td>II. Fertilizers (ex-factory, central region)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urea b/</td>
<td></td>
<td></td>
<td>9</td>
<td>53</td>
<td>233</td>
</tr>
<tr>
<td>SSP b/</td>
<td>83</td>
<td>86</td>
<td>-3</td>
<td>6</td>
<td>92</td>
</tr>
<tr>
<td>c/</td>
<td>83</td>
<td>107</td>
<td>-24</td>
<td>6</td>
<td>113</td>
</tr>
<tr>
<td>TSP (gran.) b/</td>
<td>199</td>
<td>200</td>
<td>-1</td>
<td>10</td>
<td>210</td>
</tr>
<tr>
<td>c/</td>
<td>199</td>
<td>224</td>
<td>-25</td>
<td>10</td>
<td>234</td>
</tr>
<tr>
<td>MAP (gran.) b/</td>
<td>291</td>
<td>295</td>
<td>-4</td>
<td>13</td>
<td>308</td>
</tr>
<tr>
<td>c/</td>
<td>291</td>
<td>340</td>
<td>-49</td>
<td>13</td>
<td>353</td>
</tr>
<tr>
<td>DAP b/</td>
<td></td>
<td></td>
<td>1</td>
<td>10</td>
<td>282</td>
</tr>
<tr>
<td>c/</td>
<td>273</td>
<td>320</td>
<td>-47</td>
<td>10</td>
<td>330</td>
</tr>
</tbody>
</table>

Notes:

a/ Raw materials at fixed prices, c.i.f. central region.
b/ Raw materials at adequate prices, c.i.f. central region.
c/ Necessary increase to ensure a return of 10-15 percent on investment.

Source: PETROFERTIL
for producers of raw materials would require an adjustment varying from 17 percent for phosphoric acid to 56 percent for ammonia. For basic fertilizers, the adjustments would vary between 3 percent for DAP and 36 percent for SSP, taking into account the prices for raw materials. The adjustment for TSP would be 18 percent, again taking into account the increase in raw material prices. In the case of urea, where the disparity is very high, the desirable adjustment would be around 56 percent.

Currently, private companies have postponed implementation of new projects because they have become less attractive in view of the depressed international prices. As a result, the Government is taking over responsibility for establishing new fertilizer plants through the State-owned firm, PETROBRAS.

**National and International Prices**

Figure 4 offers a comparison of the domestic and import prices as of March 1984 for similar products. From it the following conclusions can be drawn:

- Domestic prices for intermediate fertilizer products were less than international c.i.f. prices. The international c.i.f. price for ammonia was US$273/ton against the domestic retail price of US$189/ton. For phosphate rock, the international c.i.f. price was US$71/ton, while the domestic retail price was US$55/ton.

- The domestic price of urea was less than the international c.i.f. price. The domestic retail urea price was US$149/ton against the international c.i.f. price of US$188/ton. For other final products, phosphoric acid and TSP, the international c.i.f. price was higher than the national ex-factory price but less than the domestic retail price. For MAP, the international c.i.f. price was less than both the national ex-factory and domestic retail prices.
Figure 4:
National Ex-Factory Prices in Brazil and c.i.f. Prices, and International Prices (c.i.f.), March 1984

Legend:
- International Prices (c.i.f.)
- National Ex-Factory Prices
- National c.i.f. Prices

AMMONIA  PHOSPHATE ROCK  UREA  PHOSPHORIC ACID  TSP  MAP

US$/TON
Chapter 12

FERTILIZER PRICING IN COLOMBIA

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Chief of Planning
Ministry of Agriculture

I. INTRODUCTION

The ultimate objective of government intervention in fertilizers, as in any other good or input, is to increase social welfare. Without considering political and strategic issues, this objective is achieved by promoting efficient production, distribution and consumption. Fertilizer pricing policy should be formulated in such a fashion that the right amount (from a social point of view) is produced by each plant, appropriate returns over cost accrue to producers at efficient levels of production and the right amount is available to farmers at the right time and the right places. In short, the policy should ensure productive efficiency and distributive equity so that the maximum net return on agricultural activity is ensured.

In Colombia, the fertilizer distribution system is not efficient, and fertilizer prices are highly unstable. This has affected fertilizer consumption. For most crops, the intensity of fertilizer use remains comparable to, or below, the levels in Latin America on average, implying a considerable scope for more intensive use of this input.

The Government has been promoting improvements in fertilizer production and consumption. Price policy has been one of several instruments available to it. Others are import and export policies, measures relating to the transport and distribution systems, credit policy, basic research, and technical assistance to farmers. Therefore, price policy has contributed only partially to the general objective of increased efficiency.

In Colombia, the objective of the price policy is to stabilize ex-factory prices at a level compatible with the trends of costs at efficient production in the fertilizer industry. Prices are controlled not just to get "cheap" fertilizers to farmers. Rather, the intent is to offset price instability.

II. THE FERTILIZER INDUSTRY

Presently, fertilizer production in Colombia is carried out by approximately 15 companies, which are classified into the following three categories:
(1) Primary production companies--Their major products are ammonia, compound fertilizer and ammonium sulphate.

(2) Phosphate rock mining and grinding companies--Phosphate rock reserves in Colombia are relatively large but, because of geography, are difficult to mine, and the grade of ore is low; the development of reserves is still small in scale.

(3) Secondary production companies--There are several fertilizer formulating companies in the Cali, Medellin and Bogota areas that consume basic materials purchased from the primary production companies in Colombia, as well as imported materials. The products are, in principle, formulated fertilizers such as the liquid fertilizer.

At present, Colombia consumes approximately 690,000 tons of fertilizers a year, including 400,000 tons of NPK, 190,000 tons of urea and 100,000 tons of other fertilizers. The country is self-sufficient in NPK fertilizers, which are produced by two manufacturers, ABOCOL and MONOMEROS. About 95 percent of the urea requirements, on the other hand, is met by imports, as domestic production is limited to approximately 10,000 tons of urea, produced by FERTICOL, the only urea producer. Other fertilizers being used are ammonium sulphate, calfos, super phosphate and potassium chloride; total domestic production of these fertilizers amounts to 90,000 tons, and about 10 percent of the demand is met by imports.

III. THE FERTILIZER PRICING SYSTEM

Ex-Factory Prices

Price controls were introduced in Colombia in 1967 and have been modified several times since then. For example, before 1979, the system was unilateral, with the Government fixing and adjusting prices at will. Subsequently, the system was changed to "watched freedom," in which the industry could adjust its prices after informing the Government. The system worked as follows. A producer planning to increase prices presented a proposal with relevant information (costs of production, import bills, financial statements, etc.) to the Ministry of Agriculture. The ministry checked the data and calculated the increase in prices required to cover the rise in costs. The ministry had to make a decision in 90 days; otherwise, the proposal was assumed to have been approved.

This system did not preclude arbitrary decisions by Government officials. They were able to deny justified increases by freezing prices for long periods. To avoid this arbitrariness, the system has moved in recent years toward bilateral agreements between the industry and the Government.
At present, the prices for fertilizers are set as follows. Ex-factory prices are revised every three months in recognition of the fact that inflation and devaluation have accelerated in recent years to over 20 percent a year. To calculate the required increase, the different components of the price are grouped into two categories: cost of raw materials and value added. The value added is increased every quarter at a rate equal to the average rate of inflation of the country, calculated on the basis of the increase in the consumer price index. To this is added the cost of raw materials, calculated by multiplying the standard input coefficients by the last reported prices in the national and international markets. Provisions are made to include all taxes paid and take into account the effective exchange rate for imported inputs. Given the resulting average increase in prices, the industry may adjust the price of different fertilizers to ensure a logical structure of relative prices.

Stated algebraically, the formula for fixing prices is:

\[ P_t = P_i A_i + (1 + r) V_{t-1} \]

where 
- \( P_t \) = Ex-factory price of fertilizer "n" in quarter t
- \( P_i \) = Price (f.o.b. plant) of input "i", including all taxes
- \( A_i \) = Amount of input "i" needed to produce one unit of "n"
- \( r \) = Quarterly rate of inflation
- \( V_{t-1} \) = Value added per unit in quarter t-1.

While most fertilizer products in Colombia are subject to price controls, a few are not. Urea is mostly imported by one firm and has free prices. However, a Government agency will step in to import urea itself whenever the prices move out of line. For other products like ammonia, where the market consists of a bilateral monopoly (one producer, one consumer), the Government avoids fixing prices directly on the assumption that the conflicting interests of the producer and the consumer exert automatic self-control.

The ex-factory pricing system does not take into account the price of agricultural products, although it is recognized that the increasing costs of fertilizer production and resulting increases in fertilizer prices have been affecting farmers' net income. To alleviate this adverse effect, the Government has: (1) lowered to a minimum the level of taxes on imported raw materials and equipment for the fertilizer industry; (2) established a lower price for the gas used in the production of fertilizer; and (3) initiated a plan to rationalize the transportation and distribution system in order to reduce fertilizer prices at the farm level.
Retail Prices and Distribution

In recent years, the sub-optimal use of fertilizer in Colombia has also resulted from high farmgate prices that reach two or three times the world market levels: despite an overvalued exchange rate, domestic prices of fertilizer are well above international levels on account of tariffs and duties, high costs for domestic port handling, transport and marketing, and inefficiencies in the distribution and transportation systems.

The domestic fertilizer manufacturers do not own or operate themselves any outlets for the marketing and distribution of their products. All fertilizers are distributed to farmers by associations/ cooperatives of agricultural producers and private distributors. CAJA AGRARIA (a state-owned banking institution for agricultural financing), FEDERACAFE and FEDEARROZ (networks established individually by several agricultural producers' associations or cooperatives) handle most of the fertilizers distributed in the domestic markets. They purchase the fertilizers from the domestic manufacturers or importers through tenders. Other distributors or buyers purchase the fertilizers through negotiation with individual manufacturers or importers.

A free market price system is the Government's principal policy regarding the retail pricing of fertilizers, and it provides no subsidy for manufacturers or distributors for the sale of fertilizers. However, there is Governmental control with respect to the distributors' sales markup, excluding inland transportation costs, to ensure that their price does not exceed 8.8 percent of the f.o.b. plant prices or f.o.b. prices ex-port of imports on average. Under this pricing scheme, each distributor can set his own retail prices, taking into account the legislatively permitted markup.

Subsidies

Fertilizers are not directly subsidized by the Government. Nevertheless, there are some indirect subsidies. The price of gas as an input to the fertilizer industry is 35 percent below the price of gas for other purposes.\(^1\) In addition, duties on imported raw materials, spare parts and equipment for the fertilizer industry are especially low (1 percent).

Some indirect subsidies are also found at the farm level. FEDERACAFE's price for urea has been lower by 2 to 16 percent, depending on the sales region. The FEDERACAFE fertilizer is provided only to the members of this association. The Government refunds to FEDERACAFE a portion of the export tax imposed on coffee exports to compensate it for a portion of the distribution costs. Thus the association can set the retail prices at a level lower than the cost actually incurred, and thereby it indirectly subsidizes the fertilizer prices of members.

\(^1\) The price of gas for fertilizer feedstock was US$0.93 per million British thermal units on January 1, 1982.
IV. EVALUATION OF THE SYSTEM

Ex-Factory Pricing

There are two shortcomings in the ex-factory pricing system. First, the input prices used to revise the ex-factory price may not reflect closely the actual input prices paid by the industry. For instance, the last published prices in "Green Markets" and the last exchange rate are used for imported inputs. This approach may over- or understate the true value, depending on the trends of those variables. Second, the value added in the last quarter is determined by increasing at a certain rate the value added for the first quarter following the adoption of the system. Adjustments need to be made from time to time to correct for deviations.

Ex-Factory and International Prices

During 1983, the ratio between the ex-factory and international c.i.f. prices ranged between 1.26 and 1.54 for the most widely used complex fertilizers. If a series of taxes, port charges and inland transportation costs is added to the c.i.f. prices, the ratio drops substantially, to 0.88-1.07. As such, port charges and transportation costs provide substantial protection to domestic producers.

Returns in the Fertilizer Industry

According to the figures on inflation, the return on revalued fixed assets is presently quite low (less than 3 percent), and perhaps negative in some cases. However, the industry can survive economically because the fixed assets in many plants have already been fully depreciated. Further, inasmuch as the country has been in a deep recession during the last three years, low earnings and even small losses should not cause undue concern in the industry. The Government is prepared to allow the industry larger returns when the economy as a whole recovers and starts growing.

Fertilizer Prices vs. Agricultural Prices

The relationship between the prices paid by farmers for fertilizers and the prices they receive for agricultural products is not stable in Colombia. The reason is that fertilizer prices are administered, while farm product prices fluctuate according to market conditions. The Government, however, has adopted a support pricing system for certain essential crops.

In the second part of 1980, fertilizer prices rose steeply (36 percent) compared to agricultural prices. Since then, the terms have shifted in favor of farmers, although not for all products. The agricultural support prices for certain crops, have been adjusted upwards. This upward revision, however, mainly reflected increases in certain other cost components such as labor.
Chapter 13

FERTILIZER PRICING IN HUNGARY

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Senior Economic Advisor,
Plant Protection and Agrochemical Department,
Ministry of Agriculture and Food

In terms of the intensity of fertilizer use, Hungary is currently ranked eighth in the world. The average amount of nutrients applied on its six million hectares of arable land is 270-280 kg. per hectare. Fertilizer demand is met by domestic production as well as imports.

I. FERTILIZER PRICING

The main goal of the fertilizer pricing policy is to expand agricultural production and improve the competitiveness of Hungary's farm products in the world market through more efficient use of nutrients. Within that context, since 1968, the fertilizer pricing policy in Hungary has had the dual objectives of allowing market forces to determine both producer and consumer prices and, at the same time, maintaining relatively stable consumer prices. However, these objectives proved incompatible in periods of steep increases in world fertilizer prices and led to an expansive range of subsidies and tax exemptions. These had the effect of distorting the price structure to the extent that by 1977 producer prices were 4 percent higher than consumer prices. Price reforms undertaken in 1979-80 introduced the concept of "competitive prices," with producer prices being linked to world market prices. Since 1980, fertilizer ex-factory prices have moved freely with international prices. The raw materials for the fertilizer industry, mainly natural gas, coal and phosphate rock, are also purchased at world market prices. On the other hand, retail prices vary with the ex-factory prices up to a fixed maximum. If they go above the stipulated maximum, the Government subsidizes the consumer by reimbursing the distributors for the difference. The aim is to keep the consumer price at a level that encourages fertilizer consumption.

The starting point for retail pricing is the ex-factory or import price. To that is added the wholesale margin, which covers packaging and transportation to the buyer's warehouse. The cost of storage is about 20-23 Forints (Ft.) per ton of fertilizer, while other marketing costs come to 18-30 Ft. a ton. Adjustment of the retail price according to changes in the ex-factory prices takes place with a lag of about one year. Interim ex-factory price increases are covered from the budget. In addition, since 1984, an off-season rebate of 10 percent is allowed on surplus products. If the marketing companies sell products at a premium during the agricultural season, they can use the profits from that premium to provide off-season discounts.
Retail fertilizer prices are uniform in the different regions of the country. The differential transport costs are covered by the freight equalization fund, which is handled by the trading companies themselves.

In recent years, increases in fertilizer retail prices have resulted in slumps in demand. However, experience over the years since the first price increase in 1976 has shown that consumption falls in the first year following a rise in prices and then gradually increases. Any significant price increase is always combined with a modification of the prices for agricultural products.

**Subsidy**

The subsidy level is specified as a percentage of domestic production and import prices. While in the past the subsidy has varied substantially by product, from 1984 on it has been granted on the basis of nutrient content. This approach will help move consumer demand for different products more into line with world market trends.

The following figures show the trend for the fertilizer subsidy during 1973-84:

<table>
<thead>
<tr>
<th>Years</th>
<th>Subsidy (million Fts.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>2,765</td>
</tr>
<tr>
<td>1974</td>
<td>4,052</td>
</tr>
<tr>
<td>1975</td>
<td>3,676</td>
</tr>
<tr>
<td>1976</td>
<td>4,023</td>
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<td>1977</td>
<td>4,282</td>
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<tr>
<td>1978</td>
<td>4,500</td>
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<td>1979</td>
<td>4,290</td>
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<td>1980</td>
<td>5,293</td>
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<td>1981</td>
<td>6,428</td>
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<tr>
<td>1982</td>
<td>6,094</td>
</tr>
<tr>
<td>1983a/</td>
<td>6,620</td>
</tr>
<tr>
<td>1984b/</td>
<td>5,350</td>
</tr>
</tbody>
</table>

*a/ Preliminary  
b/ Estimated.

In recent years, the Government's policy has been to reduce the subsidy to ease the pressure on the budget, and the amount of the subsidy has been decreasing accordingly. This decline is attributable to increases in fertilizer prices. One outcome has been to generate interest in more efficient fertilizer use.

**Foodgrain Pricing**

At current price levels, foodgrain crops are the most profitable products in the agricultural sector, partly because changes in production costs are offset by changes in the sale prices of grains. A
pricing authority from time to time sets a reference price, which producers may alter by 5 percent in either direction, taking into account supply and demand.

II. IMPROVING FERTILIZER USE

Under the new pricing system, fertilizer and crop prices reflect world market prices. As a result, the competitiveness of both the fertilizer and agricultural sub-sectors has been enhanced. The policy of tying ex-factory prices to international prices yielded domestic manufacturers in 1981 an average return of 13 percent on investment. Subsequently, the sharp decline in world market prices attributable to the worldwide recession approximately halved this return.

As fertilizers account for a significant part of the total crop production costs, farmers are induced to look for ways to improve the efficiency of use of fertilizers. The Government has initiated several programs in this area. Since 1976, the Department of Plant Protection and Agrochemistry of the Ministry of Agriculture and Food has been identifying the conditions and prerequisites for efficient use of fertilizers. A number of laboratories for soil testing have been established, and compulsory soil tests are carried out in different regions every three years. The test results are processed by computer and are used in providing guidelines for nutrient use for different crops in different regions. With the increasing application of liquid fertilizers, further increases in efficient fertilizer use have been taking place. For example, the amount of fertilizer required to produce 100 kg. of wheat has declined since 1975 from about 8 kg. to 7.5 kg.

Attention is being given to improving the quality of fertilizer products, reducing fertilizer losses in transportation and application, and improving and expanding storage facilities. Stocks now are held at a limited number of warehouses. However, marketing companies have a storage capacity equivalent to about only 5 percent of demand. Given this paucity of storage space, the seasonal variation in demand leads to problems in supplying fertilizers to farmers in a timely manner. To overcome this problem, a program to construct 180 warehouses, each with a capacity of 100,000 tons, has been initiated. As of now, 37 have been completed and 27 are under construction. These facilities are being financed by the marketing companies in cooperation with the farmers.

Since January 1982, the Government has also been allowing domestic manufacturers to distribute fertilizer products along with the trading companies. Moreover, efforts are being made to improve the fertilizer transportation system. The average cost of fertilizer transportation is now 210 Ft./ton. To reduce this cost, a plan has been worked out involving river transportation and more rational surface movement of fertilizers.
Chapter 14

FERTILIZER PRICING IN YUGOSLAVIA

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Advisor
INA, Petrokimija

I. STATUS OF FERTILIZER SUPPLIES

At present, the average consumption of fertilizers in Yugoslavia is low, approximately 100 kg. per hectare of arable land. However, there is substantial variation within the country. The average in the social sector is about 200 kg. per hectare, while in the private farming sector it is about 67 kg. per hectare, three times lower. Of the total arable land, the private sector accounts for about 81 percent, while the remaining 19 percent belongs to the social sector. The social sector consists of Agrokombinats, which own their land and operate on a large scale with modern, capital-intensive facilities and well-trained staff. The private sector consists of the cooperatives (associations of individual farmers) and individual farmers. Consumption of fertilizers also varies by region, ranging from approximately 27 kg. per hectare of arable land in Monte Negro to 205 kg. per hectare in Vojvodina.

Fertilizer supplies come from both domestic production and imports. There are 11 fertilizer-producing enterprises located in five Republics and two Autonomous Provinces. Between 1975 and 1982, no new production capacity for nitrogen fertilizers was added. On the other hand, the phosphatic fertilizer capacity was increased during that period. Of the total existing capacity of 608,000 tons of nitrogen in the form of CAN, urea and complex fertilizers, approximately 177,000 tons are based on imported intermediate products. The present production capacity for primary phosphates is 546,000 tons of P₂O₅ a year against a finished NPK processing capacity of 314,000 tons of P₂O₅ a year. A new plant for production of both nitrogen and phosphatic fertilizers with a capacity of 1.2 million tons a year was put into operation at the end of 1983 in Kutina, located in the middle of the Socialist Republic of Croatia, the center of the main region of consumption. INA-Petrokimija, Kutina, is the largest manufacturer, supplying about 40 percent of total domestic demand.

The plans for new fertilizer capacity have been based on the goal of increasing the production of foodstuffs and the consequent need for increased fertilizer consumption. This is particularly true for private farms, where supply shortages have precluded significant increases in fertilizer consumption. The capacity added in recent years will allow an increase in fertilizer production of up to 5 million tons a year, accounting for 0.8 million nutrient tons of nitrogen and 0.6 million nutrient tons of phosphorous.
Historically, Yugoslavia's nitrogen production has relied substantially on imports of ammonia, nitrogen solutions and ammonium sulphate for further processing into calcium ammonium nitrate (CAN) and complex (NPK) fertilizers. The shortage of foreign exchange for imports of raw materials has been a major constraint to increased production. Until 1982, the major source of foreign exchange for the fertilizer industry was mandatory exports of finished fertilizers. However, fertilizer exports meant less availability for the domestic market. Thus, Yugoslavia faced a real dilemma—if exports were reduced to increase domestic fertilizer availability, the industry would not have the necessary foreign exchange to import raw materials, resulting in reduced fertilizer production.

Between 1975-82, Yugoslavia was a net importer of urea (25 percent of urea production) and a net exporter of NPK (16 percent of NPK production). As for phosphatic fertilizers, Yugoslavia has been a net exporter. The phosphatic industry is based almost entirely on indigenous resources. In recent years, the balance of payments deficit has necessitated a cutback in imports.

Tables 1-4 show the breakdown of supplies, including domestic production, and consumption in Yugoslavia from 1975 to 1982.

Table 1: TREND IN FERTILIZER PRODUCTION
('000 tons)

<table>
<thead>
<tr>
<th>Type of fertilizer</th>
<th>1975</th>
<th>1977</th>
<th>1979</th>
<th>1981</th>
<th>1982</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogenous</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAN 27% N</td>
<td>672</td>
<td>788</td>
<td>809</td>
<td>755</td>
<td>743</td>
</tr>
<tr>
<td>Ammonium sulfate</td>
<td>12</td>
<td>11</td>
<td>8</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Urea</td>
<td>173</td>
<td>183</td>
<td>180</td>
<td>183</td>
<td>179</td>
</tr>
<tr>
<td>Nitrogen solutions, 41% N</td>
<td>20</td>
<td>11</td>
<td>7</td>
<td>18</td>
<td>13</td>
</tr>
<tr>
<td>Phosphatic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Super phosphate</td>
<td>132</td>
<td>70</td>
<td>142</td>
<td>179</td>
<td>177</td>
</tr>
<tr>
<td>Triple super phosphate</td>
<td>445</td>
<td>418</td>
<td>321</td>
<td>390</td>
<td>371</td>
</tr>
<tr>
<td>Basic slag (ground)</td>
<td>-</td>
<td>4</td>
<td>6</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>Complex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPK</td>
<td>1,210</td>
<td>1,430</td>
<td>1,631</td>
<td>1,812</td>
<td>1,778</td>
</tr>
<tr>
<td>Mixed NPK</td>
<td>184</td>
<td>117</td>
<td>88</td>
<td>72</td>
<td>-</td>
</tr>
<tr>
<td>MAP</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>140</td>
<td>111</td>
</tr>
<tr>
<td>Total (product)</td>
<td>2,848</td>
<td>3,032</td>
<td>3,192</td>
<td>3,568</td>
<td>3,386</td>
</tr>
<tr>
<td>In which:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrogen</td>
<td>396</td>
<td>463</td>
<td>497</td>
<td>518</td>
<td>498</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>243</td>
<td>278</td>
<td>314</td>
<td>403</td>
<td>371</td>
</tr>
</tbody>
</table>

Source: Agrohemija, Belgrade, 1983.
### Table 2: IMPORTS OF FERTILIZERS
('000 tons)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total imports</td>
<td>254</td>
<td>208</td>
<td>315</td>
<td>505</td>
<td>485</td>
</tr>
<tr>
<td>In which: Nitrogen</td>
<td>97</td>
<td>122</td>
<td>151</td>
<td>223</td>
<td>192</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>26</td>
<td>37</td>
<td>71</td>
<td>67</td>
<td>42</td>
</tr>
</tbody>
</table>


### Table 3: FERTILIZER EXPORTS
('000 tons)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total exports</td>
<td>338</td>
<td>371</td>
<td>465</td>
<td>356</td>
<td>512</td>
</tr>
<tr>
<td>In which: Nitrogen</td>
<td>24</td>
<td>37</td>
<td>53</td>
<td>38</td>
<td>54</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>62</td>
<td>63</td>
<td>93</td>
<td>68</td>
<td>136</td>
</tr>
</tbody>
</table>


### Table 4: FERTILIZER CONSUMPTION BY NUTRIENTS
('000 tons unless otherwise noted)

<table>
<thead>
<tr>
<th></th>
<th>(N+P₂O₅+ K₂O)</th>
<th>Nitrogen (N)</th>
<th>Phosphorus (P₂O₅)</th>
<th>Average specific consumption of fertilizer, per ha. of arable land (kg.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>720</td>
<td>360</td>
<td>197</td>
<td>72</td>
</tr>
<tr>
<td>1976</td>
<td>738</td>
<td>382</td>
<td>188</td>
<td>74</td>
</tr>
<tr>
<td>1977</td>
<td>802</td>
<td>402</td>
<td>205</td>
<td>81</td>
</tr>
<tr>
<td>1978</td>
<td>855</td>
<td>425</td>
<td>220</td>
<td>86</td>
</tr>
<tr>
<td>1979</td>
<td>870</td>
<td>440</td>
<td>220</td>
<td>86</td>
</tr>
<tr>
<td>1980</td>
<td>824</td>
<td>417</td>
<td>209</td>
<td>83</td>
</tr>
<tr>
<td>1981</td>
<td>1,010</td>
<td>477</td>
<td>268</td>
<td>101</td>
</tr>
<tr>
<td>1982</td>
<td>940</td>
<td>463</td>
<td>235</td>
<td>96</td>
</tr>
</tbody>
</table>

II. FERTILIZER PRICING

In Yugoslavia, the Government emphasizes:

- The need to raise domestic fertilizer production to increase consumption; and
- The need to increase agricultural production in which Yugoslavia has a comparative advantage.

The Federal Secretariat for Markets and General Economics, in close collaboration with Agrohemija (the association of fertilizer producers) and the fertilizer producers and users, is responsible for determining prices. Periodic reviews are made, taking into consideration the world market and domestic production costs.

**Ex-Factory Pricing**

In Yugoslavia, the ex-factory fertilizer price is determined taking into account international export prices as well as the domestic retail prices in neighboring countries. Efforts are being made to bring the domestic prices of finished fertilizers into line with world market prices. Three of the four ammonia plants have very high energy consumption. The reason is that these plants were commissioned during 1969-70 when energy costs were low, and they were designed on the basis of minimizing initial investment cost, even though this implied relatively high consumption during operations. As compared to the present cost of imported ammonia of about US$175 a ton c.i.f, the direct economic production costs of ammonia in the three existing plants range from US$246 to $283 a ton (excluding depreciation, interest and capital charges), with a weighted average of US$262 a ton. In the phosphatic fertilizer industry, prices are roughly in line with the prices of imports.

The Government sets ex-factory prices for different fertilizer products based on their nutrient content. The prices are usually fixed once or twice a year (more than twice is exceptional) by the Federal Executive Council. Apart from the price movements in the world market as well as in the domestic markets of neighboring countries, the following factors are taken into account:

- Supply and demand of fertilizers in the country;
- Changes in input prices;
- Conditions in the fertilizer industry and levels of capacity utilization;
- Delivery terms and other important conditions of sale; and
- The extent to which fertilizer prices affect the prices of basic agricultural products.
As of December 31, 1983, the ex-factory prices for the different nutrients were:

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>US$</th>
<th>Dinars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen (kg.)</td>
<td>0.40</td>
<td>50.12</td>
</tr>
<tr>
<td>P₂O₅ (water soluble) (kg.)</td>
<td>0.47</td>
<td>58.66</td>
</tr>
<tr>
<td>P₂O₅ (citric soluble) (kg.)</td>
<td>0.40</td>
<td>50.00</td>
</tr>
<tr>
<td>K₂O (kg.)</td>
<td>0.166</td>
<td>20.845</td>
</tr>
<tr>
<td>Additive for complex NPK, plus the costs of processing, and granulation and bagging (ton)</td>
<td>21</td>
<td>2,640</td>
</tr>
<tr>
<td>Additive for mixed NPK, plus the costs of processing, granulation and bagging (ton)</td>
<td>10</td>
<td>1,280</td>
</tr>
</tbody>
</table>

The maximum ex-factory (bagged) prices f.o.r./f.o.t. (free on rail/free on truck) for the basic commercial fertilizer types based on the above prices were:

<table>
<thead>
<tr>
<th>Fertilizer</th>
<th>US$/ton</th>
<th>Dinars/ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urea (46% N)</td>
<td>184</td>
<td>23,055</td>
</tr>
<tr>
<td>CAN (27% N)</td>
<td>108</td>
<td>13,532</td>
</tr>
<tr>
<td>NPK (15-15-15)</td>
<td>176</td>
<td>22,103</td>
</tr>
</tbody>
</table>

A 2 percent wholesale margin and a 4 percent retail margin are allowed on these ex-factory prices. As most of the large-scale fertilizer plants are located in the centers of the consuming regions, transportation costs are estimated for a distance not to exceed 200 km. Some manufacturers have, however, unofficially increased the fixed prices 10 to 20 percent, mainly for two reasons:

- Fertilizer demand has been higher than supply; and
- The rise in input costs as compared with output prices, mainly attributable to the decline in the value of the dinar with respect to hard currencies.

**Farmgate Pricing**

The Government subsidized for several years the consumption of fertilizers at a rate equal to 20 percent of the fixed retail price. The increasing burden of the subsidy on the budget, however, led it to review the subsidy policy. In 1977, it decided to reduce the subsidy by a third each year for three years. In January 1980 the subsidy was abolished totally and retail prices were raised. One result of the elimination of this subsidy was a rise in the prices of agricultural products. Table 5 shows the composition of final consumer prices for selected fertilizers.
Table 5: FERTILIZER PRICES FOR CONSUMERS AT THE END OF 1983
(US$/ton unless otherwise noted)

<table>
<thead>
<tr>
<th>Element</th>
<th>Urea (46% N)</th>
<th>CAN (27% N)</th>
<th>NPK (15-15-15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ex-factory fertilizer price</td>
<td>184.00</td>
<td>108.00</td>
<td>176.40</td>
</tr>
<tr>
<td>Wholesale margin (2%)</td>
<td>3.70</td>
<td>2.20</td>
<td>3.50</td>
</tr>
<tr>
<td>Retail sales margin (4%)</td>
<td>7.30</td>
<td>4.30</td>
<td>7.10</td>
</tr>
<tr>
<td>Average transportation costs (based on an average distance of 200 km.)</td>
<td>5.60</td>
<td>5.60</td>
<td>5.60</td>
</tr>
<tr>
<td>Loading, unloading and distribution costs (based on an average distance of 15 km.)</td>
<td>4.40</td>
<td>4.40</td>
<td>4.40</td>
</tr>
<tr>
<td>Total</td>
<td>205.00</td>
<td>124.50</td>
<td>197.00</td>
</tr>
<tr>
<td>Additional costs as a % of ex-factory prices</td>
<td>11.4</td>
<td>15.3</td>
<td>11.7</td>
</tr>
<tr>
<td>Price per unit of nutrients (in US$/kg):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrogen</td>
<td>.446</td>
<td>.461</td>
<td>.508</td>
</tr>
<tr>
<td>P₂O₅</td>
<td>-</td>
<td>-</td>
<td>.597</td>
</tr>
<tr>
<td>K₂O</td>
<td>-</td>
<td>-</td>
<td>.211</td>
</tr>
</tbody>
</table>

Source: Agrohemija, Belgrade.

The quality of fertilizers is mandated by law. Precise technical standards have been established, along with techniques for quality control and sampling.

III. AGRICULTURAL PRODUCTS AND FERTILIZER PRICES

Agricultural Product Pricing

The pricing of agricultural products is one of the most complex exercises. It is particularly an issue in Yugoslavia because of the high rate of private ownership of farms. On the other hand, the social sector accounts for almost 30 percent of the total production of the main foodgrains in the country.

The prices of agricultural products are determined based on the following:
  o Supply and demand for agricultural products;
Indicators of the efficiency of production in the social agricultural sector (measured according to the level of production, position of agriculture in the economy, etc.);

Price movements of the main agricultural products in the world market;

Price movements of agricultural inputs (seeds, fertilizers, protective chemicals, fuel, equipment, etc.);

Influence of agricultural product prices on the standard of living; and

Measures taken to transform Yugoslavia into a food exporter, which will require that its prices be competitive with international market prices.

Based on these factors, two sets of prices—producer and protected—are set for agricultural products. They are derived on the basis of parity in relation to the commercial price of wheat.

**Producer prices.** Producer prices are determined in the current year and are valid for the following year. They serve as approximate base prices for:

- Determining the optimum scope and structure of agricultural production;
- Production planning, contracting, etc.;
- Purchasing and sale of surplus products; and
- Fixing the price of processed agricultural products.

According to their structure and purpose, the prices correspond for the most part to the "indicative prices" of the European Economic Community (EEC).

**Protected Prices.** Farmers are guaranteed a floor, or protected price, for all surplus products. The protected prices correspond to the "intervening prices" of the EEC.

The long-term plans for economic stabilization call for agricultural pricing to be based on market forces. As such, non-economic factors should be abandoned to the extent possible. This goal is considered important for accelerating agricultural development and transforming Yugoslavia into a food exporter.
The relationship between retail fertilizer prices and those of the main food crops has been estimated here with reference to the producer prices of wheat, maize and sugar beet. At the end of 1983, a private farmer could exchange a ton of fertilizer for the following tons of agricultural products:

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Wheat</th>
<th>Maize</th>
<th>Sugar beet</th>
</tr>
</thead>
<tbody>
<tr>
<td>For 1 ton of urea (46% N)</td>
<td>1.52</td>
<td>1.69</td>
<td>5.72</td>
</tr>
<tr>
<td>For 1 ton of CAN (27% N)</td>
<td>0.92</td>
<td>1.02</td>
<td>3.48</td>
</tr>
<tr>
<td>For 1 ton of NPK (15-15-15)</td>
<td>1.46</td>
<td>1.62</td>
<td>5.50</td>
</tr>
</tbody>
</table>

The figures below show the incremental yields from fertilizers. Based on quantities of 120 kg. per hectare of nitrogen, 90 kg. per hectare of phosphorus and 120 kg. per hectare of potash, i.e., 330 kg. of nutrients per hectare, the incremental crop yield for wheat was:

- For 1 kg. of nitrogen: 18 kg. of wheat
- For 1 kg. of phosphorus: 6 kg. of wheat
- For 1 kg. of potash: 2.8 kg. of wheat

Given the composition of fertilizers used in Yugoslavia—an average of about 48 percent nitrogen, 25 percent phosphorus and 25 percent potash—an average increase of about 11 kg. in wheat production per kg. of nutrient can be expected. Based on average retail fertilizer prices and the commercial prices of wheat, every dollar used for fertilizers yields a net return of US$2.28.

The following table compares the differences in average yields for wheat and maize for social and private farms in 1979, against the per hectare use of fertilizers.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Wheat</th>
<th>Maize</th>
<th>Fertilizer nutrient consumption (N+P\textsubscript{2}O\textsubscript{5}+K\textsubscript{2}O), kg./ha.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Social sector</td>
<td>4.58</td>
<td>6.46</td>
<td>198</td>
</tr>
<tr>
<td>B. Private sector</td>
<td>2.93</td>
<td>3.96</td>
<td>67</td>
</tr>
<tr>
<td>Total (average)</td>
<td>3.36</td>
<td>4.22</td>
<td>88</td>
</tr>
<tr>
<td>C. Difference in favor of the social sector (A - B)</td>
<td>1.65</td>
<td>2.50</td>
<td>131</td>
</tr>
</tbody>
</table>

The data show clearly the opportunities for improving food production on private farms, provided sufficient quantities of fertilizers are available.
IV. EVALUATION OF EX-FACTORY PRICING

The ex-factory prices paid for fertilizers do not cover the costs of production of every plant. For the most part, they have been set on the basis of production costs in plants commissioned in 1968 or before. These plants have already been depreciated. On the other hand, new fertilizer plants like the Fertilizer Complex Kutina 2 were built at far higher capital costs in real terms. The share in production costs at the Kutina facility attributable to invested capital (i.e., depreciation and interest charges) is approximately 33 percent. This element does not apply to the already depreciated plants.

Domestic ex-factory fertilizer prices should be modified to reflect these differences in capital costs. Moreover, this modification should take into account such factors as inflation, currency realignments, high capital charges and the economic effects of the energy crisis in general, all of which have led to high input prices.

Based on the production costs in new plants with large daily capacities (1,360 tons of ammonia, 1,500 tons of urea, 1,500 tons of sulphuric acid, 500 tons of phosphoric acid and 1,600 tons of MAP/NPK a day), the prices for the different nutrients should be fixed at:

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>US$/kg.</th>
<th>Index (actual ex-factory price=100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen (N)</td>
<td>0.565</td>
<td>141</td>
</tr>
<tr>
<td>Phosphorus ((P_2O_5))</td>
<td>0.630</td>
<td>134</td>
</tr>
<tr>
<td>Potash ((K_2O))</td>
<td>0.176</td>
<td>106</td>
</tr>
<tr>
<td>Additive for complex NPK</td>
<td>30/ton</td>
<td>143</td>
</tr>
</tbody>
</table>

These ex-factory price levels at the end of 1983 in real terms would have justified investment in new plants in recent years and will encourage investment in the fertilizer industry up to the year 2000.

Some benchmarks that should be taken into account in the determination of ex-factory fertilizer prices are:

- Ninety percent utilization of installed capacity.
- A plant construction period of 4 years and a payback period for capital costs of 10 years.
- Prices for basic raw materials at the end of 1983 in real terms: US$3.20/thousand standard cubic feet (MSCF) for natural gas; US$105/ton for potassium chloride; US$71/ton for rock phosphate; and US$155/ton for elemental sulphur.
Based on the above factors, the ex-factory prices for fertilizers should be:

<table>
<thead>
<tr>
<th></th>
<th>US$/ton</th>
<th>1983=100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urea (46% N)</td>
<td>260</td>
<td>142</td>
</tr>
<tr>
<td>CAN (27% N)</td>
<td>155</td>
<td>123</td>
</tr>
<tr>
<td>NPK (15-15-15)</td>
<td>235</td>
<td>112</td>
</tr>
</tbody>
</table>

One policy issue in this context is how to provide these higher prices given the present low prices for foodgrains.

It is possible to design a separate formula for fixing the ex-factory fertilizer prices of older plants that are already fully depreciated, based on their production costs (excluding depreciation). These prices are estimated for the end of 1983 in real terms as follows:

<table>
<thead>
<tr>
<th></th>
<th>US$/kg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen (N)</td>
<td>0.511</td>
</tr>
<tr>
<td>Phosphorus (P2O5)</td>
<td>0.570</td>
</tr>
<tr>
<td>Potash (K2O)</td>
<td>0.176</td>
</tr>
<tr>
<td>Additive for complex NPK</td>
<td>27/ton</td>
</tr>
</tbody>
</table>

The ex-factory prices for the finished products from old plants would then be:

<table>
<thead>
<tr>
<th></th>
<th>US$/ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urea (46% N)</td>
<td>235</td>
</tr>
<tr>
<td>CAN (27% N)</td>
<td>138</td>
</tr>
<tr>
<td>NPK (15-15-15)</td>
<td>215</td>
</tr>
</tbody>
</table>

This approach, if followed, will lead to an average increase in the actual prices paid at the end of 1983 as follows:

<table>
<thead>
<tr>
<th></th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>Up 27.5</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>Up 21.3</td>
</tr>
<tr>
<td>Potash</td>
<td>Up 6.0</td>
</tr>
<tr>
<td>Additive for complex NPK</td>
<td>Up 28.6</td>
</tr>
</tbody>
</table>

Those increases, in turn, should raise the prices of finished fertilizers by an average of about 24.3 percent, ranging from 21.9 percent for NPK (15-15-15) to 27.7 percent for urea (46% N) and CAN (27% N).
Unless the new plants are ensured a reasonable rate of return on investment at efficient levels of operations, the investments planned by the year 2000 are uncertain. Yet these investments are necessary for the desired growth in agricultural production. Unless expansion of capacities at existing large fertilizer plants that are already depreciated is possible, new plants at greenfield sites are necessary.

V. DOMESTIC AND INTERNATIONAL FERTILIZER PRICES

Table 6 compares Yugoslavia's fertilizer export prices with its ex-factory domestic prices.

<table>
<thead>
<tr>
<th>Product (bagged)</th>
<th>Ex-factory price (f.o.r./f.o.t)</th>
<th>Estimated export price (f.o.r./f.o.t.)</th>
<th>Required ex-factory price for new plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urea (46% N)</td>
<td>184</td>
<td>130</td>
<td>260</td>
</tr>
<tr>
<td>CAN (27% N)</td>
<td>108</td>
<td>90</td>
<td>155</td>
</tr>
<tr>
<td>NPK (15-15-15)</td>
<td>176</td>
<td>150</td>
<td>235</td>
</tr>
</tbody>
</table>

Source: Agrohemija, Belgrade.

From the above it can be concluded that:

- Domestic ex-factory fertilizer prices in Yugoslavia are not based on the export prices. They are based largely on the domestic fertilizer prices in neighboring countries.

- The export prices at the end of 1983 did not reflect the reasonable price level required to justify new investment in the fertilizer industry. Yugoslavia exported finished fertilizers at depressed 1983 prices to earn the foreign exchange necessary to import raw materials for fertilizers. These prices approximated only the variable costs of Yugoslavia's fertilizer industry.

- The domestic ex-factory prices in 1983 were causing losses for producers, which they tried to cover by unofficial increases of 10-15 percent over the approved prices or by other steps.
The low domestic ex-factory prices discourage the construction of the new fertilizer plants that are critical to greater food production. As such, the achievement of the food production targets depends on the major fertilizer plants now in operation. Because these plants are already depreciated, they produce fertilizers at lower costs.

Fertilizers are bulky and of relatively low value, and cost a disproportionate amount to transport. This situation quite often protects domestic manufacturers from substantial imports available at relatively low prices, despite high domestic prices. Neighboring countries of Western Europe also set their domestic prices in this way. The wholesale prices in these countries are much higher than export prices and are even higher than the prices in Yugoslavia. Presented below are some of the domestic wholesale prices for two fertilizers in Yugoslavia and selected neighboring countries at the end of 1983:

<table>
<thead>
<tr>
<th>CAN (27% N)</th>
<th>US$/ton</th>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>(while export price was US$90 a ton)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yugoslavia</td>
<td>115.80</td>
<td>100.0</td>
</tr>
<tr>
<td>Austria</td>
<td>179.20</td>
<td>154.7</td>
</tr>
<tr>
<td>Germany, F.R.</td>
<td>172.80</td>
<td>149.2</td>
</tr>
<tr>
<td>France</td>
<td>145.20</td>
<td>125.4</td>
</tr>
<tr>
<td>Italy</td>
<td>135.70</td>
<td>117.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NPK (15-15-15)</th>
<th>US$/ton</th>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>(while export price was US$150 a ton)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yugoslavia</td>
<td>185.50</td>
<td>100.0</td>
</tr>
<tr>
<td>Germany, F.R.</td>
<td>213.40</td>
<td>115.0</td>
</tr>
<tr>
<td>Italy</td>
<td>198.20</td>
<td>107.0</td>
</tr>
<tr>
<td>France</td>
<td>193.00</td>
<td>104.0</td>
</tr>
</tbody>
</table>

These data show that the prices of fertilizers in Yugoslavia are either lower than or close to the domestic prices of neighboring countries.

VI. INCREASING THE USE OF FERTILIZERS

In 1983, the Government set forth a number of objectives in its Program of Economic Stabilization for the country, including the following:

- Obtain greater insight into existing economic problems;
- Prepare a long-term development strategy for the country; and
- Eliminate the disparities between domestic and international prices.
The program gives high priority to the development of agriculture, a crucial part of Yugoslavia's economy, by increasing the use of fertilizers.

**Improving the Application of Fertilizers**

In Yugoslavia, a focus on greater fertilizer consumption is essential, given the high level of private ownership of farms and their low rate of use, which averages only 67 kg. of nutrients per hectare of arable land. If the various measures are carried out as expected, average fertilizer consumption should reach 145 kg. per hectare of arable land, against the present average rate of 100 kg.

The measures for improving fertilizer use can be divided into two groups. One includes measures that directly increase usage and efficiency. The other comprises a larger number of indirect measures to influence efficiency; they relate to numerous factors beyond production and marketing. All measures must evolve within a difficult balance of payments situation and import restrictions. As such, it is important to increase the installed capacity for fertilizer production.

With respect to the indirect measures for increasing the use of fertilizers, the following should be noted:

- Total agricultural production, a priority in economic policy, is strongly affected by such factors as prices, investments, loans, credits and taxes. To date, not enough emphasis has been placed on agriculture, especially in the private sector, which has for a long time been working under relatively unfavorable conditions.

- By providing increased resources, the material base of villages will be improved in general, with particular attention to better utilization of cultivated land. Other measures are to bring uncultivated land into use; develop associations of farmers, in particular making the cooperatives independent and improving them as a general model for farmer associations; and developing different forms of long-term associations relating to specialization, the distribution of work and cooperation with the social sector.

- Social resources will be used to accelerate changes in the production structure of the village. In particular, there will be increased agricultural investments for village infrastructure, agricultural credits, etc.

- As farms are abandoned, the elderly are left with the responsibility for agriculture. One approach is to expand the social sector by buying that private farming land, giving the elderly pensions in return for the land they are unable to cultivate. This step will encourage modernization and promote agricultural production and productivity.
Economic policy measures and better distribution of work will be used to promote faster growth of draft livestock, which are somewhat scarce now. This measure is a precondition for a general intensification of rural development in both the social and private sectors. The social sector, together with private farmers, should be given responsibility for intensive, long-term development of draft livestock.

Promotion of various forms of associations of farmers, e.g., agricultural cooperatives and organizations of contract farmers, as well as support for those farmers contracting with the social sector, should be carried out. Associations are an excellent means to disseminate information.

Irrational utilization and fragmentation of farming land should be prevented through modification of the legal provisions concerning land inheritance. Cultivated areas should be enlarged by systematic measures and loans on favorable terms.

To be properly organized, the marketing of agricultural products requires adequate incentives for more efficient transportation and distribution.

Long-term plans for the fertilizer industry should be made and agreed to early on with producers and farmers' associations. Consideration should be given to the best geographic plant location and to alternative nutrients such as waste and rubbish.

The efficiency of agricultural experts to provide extension services should be improved.

The goal of the above measures is to achieve a total agricultural production by the year 2000 of 7.0 million tons of wheat (versus 5.5 million in 1983), 20.5 million tons of maize (versus 10.7 million in 1983), and 10.5 million tons of sugar beet. These levels assume consumption of 3.0 million tons of nutrients.

Other Measures

Measures are also planned in the areas of fertilizer production and packing, transportation and servicing. These measures will be adapted to the needs of each region.

Production and Packing. In terms of production, the main strategy will be to increase the concentration of active ingredients in a ton of commercial fertilizer. Initially, the average nutrient content was 25 percent or less. Today it is 40 percent and should reach more than 50 percent as higher capacity utilization is achieved at the Kutina II Fertilizer Complex, where special efforts have been made to improve the
quality of fertilizers. A further strategy is to make available a wider variety of fertilizers.

Another measure is to treat fertilizers (for example, by amino-coating) as well as to coat them with special mineral and chemically protective additives. This will reduce the additional costs of fertilizer application to a great extent.

Most nutrients are packed in plastic polyethylene bags of 50 kg., and this is likely to hold true in the near future. This packing requires pallets to achieve certain savings in the packing cycle. Experiments with a larger bag model have shown the feasibility of bagging in units of 500 to 2,500 kg., especially appropriate for the social sector. At the same time, it is planned to increase the range of fertilizers available in small bags for small holdings, which have been growing in number.

Transport. The transportation cost per ton per km. is 2-2.4 times more expensive by road than by railway (more than 3 times if the calculation is based on energy consumption per ton per km.). However, the proportion of rail transport is not likely to be increased because of the inconvenience of double handling. As such, efforts are being made to improve the services of road transporters. In addition, special TD-wagons are often used often to transport fertilizers in bulk, and return loads are being encouraged.

Fertilizer Availability, Delivery, Sales Policy and Servicing. Financial measures have been taken to improve the continuity of fertilizer deliveries throughout the year. In particular, discounts are offered during the off-season, supported by financing for the construction of consumer warehouses, easier access to loans during the off-season and other measures.

The share of bulk deliveries of basic fertilizers will be increased by the construction of warehouses and distribution terminals in the main consumption centers and ports of delivery and destinations. At the same time, the procedures for blending, additional treatment and packing of fertilizers at different facilities (as required), as well as laboratory testing, will be decentralized in order to provide a wide range of fertilizers.

The routine services available through the laboratories at fertilizer factories help promote efficient use of fertilizers, as do other technical services such as demonstrations, tests and experiments, promotion campaigns, etc.
Chapter 15

FERTILIZER PRICING IN TURKEY

Suna Niron
Senior Expert
State Planning Organization

I. INTRODUCTION

Fertilizer is universally recognized as one of the most important inputs for increased agricultural productivity. In Turkey, a major portion of the agricultural land is already under cultivation, and any further increase in production will have to come mostly through greater yields. Consequently, the Government gives fertilizer production and consumption a high priority.

The Government sets both ex-factory and farmer prices for fertilizers, with the advice of the State Planning Organization. Prices are issued in the form of decrees. Another state organization, Turkiye Zirai Donatim Kurumu (DONATIM), is responsible for the procurement of fertilizers from plants in Turkey and from imports, and for their distribution to farmers throughout the country. DONATIM handles all fertilizers except those used in the production of sugar, which are handled by Turkiye Seker Fabrikalari A.S. (Turkey Sugar Company, or SEKER).

DONATIM and SEKER, the two distributing agents, play a crucial role in the fertilizer sector. In general, DONATIM buys fertilizers from plants in Turkey at above-world prices and sells to farmers at below-world prices. The difference is called the "duty loss" and is a reasonable measure of the real subsidy given to farmers and the fertilizer industry. The subsidy rose in the 1970s both in real and nominal terms (Table 1). In 1981, it amounted to 4 percent of total Government expenditures, or about 1 percent of Turkish national income. This subsidy, because it is such a burden, has become an increasingly important policy issue, and in 1982 the Government stated that it would eliminate the fertilizer subsidy over a period of 5 to 10 years.

II. THE STRUCTURE OF THE FERTILIZER INDUSTRY

Production Capacity and Consumption

Production started in Turkey in 1939 on a small-scale: ammonium sulphate was produced as a byproduct at the Karabuk Iron and Steel Works. Expansion of capacity was slow, and by 1968 Turkey was still producing less than a quarter of its consumption. At that time, the Government announced a policy of meeting most of the demand domestically, and since 1972 there has been a fivefold expansion in production.
Table 1: FERTILIZER SUBSIDIES IN TURKEY, 1974-82
(billion Turkish lira)

<table>
<thead>
<tr>
<th>Year</th>
<th>In current prices</th>
<th>In constant 1974 prices</th>
<th>In nominal US$ million</th>
</tr>
</thead>
<tbody>
<tr>
<td>1974</td>
<td>1.0</td>
<td>1.0</td>
<td>71</td>
</tr>
<tr>
<td>1975</td>
<td>2.6</td>
<td>2.6</td>
<td>173</td>
</tr>
<tr>
<td>1976</td>
<td>3.7</td>
<td>3.2</td>
<td>231</td>
</tr>
<tr>
<td>1977</td>
<td>4.5</td>
<td>3.1</td>
<td>237</td>
</tr>
<tr>
<td>1978</td>
<td>11.4</td>
<td>4.7</td>
<td>438</td>
</tr>
<tr>
<td>1979</td>
<td>24.6</td>
<td>5.4</td>
<td>586</td>
</tr>
<tr>
<td>1980</td>
<td>38.1</td>
<td>3.9</td>
<td>605</td>
</tr>
<tr>
<td>1981</td>
<td>68.1</td>
<td>5.3</td>
<td>619</td>
</tr>
<tr>
<td>1982</td>
<td>64.6</td>
<td>3.7</td>
<td>445</td>
</tr>
</tbody>
</table>

Source: State Planning Organization, Statistics of Foreign Trade.

Seven companies now produce fertilizers exclusively, of which two are in the public sector, two are joint ventures, and three are privately owned. In addition, three publicly-owned companies—one petrochemical and two steel—produce fertilizers as byproducts. Table 2 shows the breakdown of capacity by company. In 1982, the domestic production capacity of nitrogenous fertilizers was 569,700 nutrient tons in the public sector, 221,200 nutrient tons in the joint sector and 246,100 nutrient tons in the private sector. The capacity of phosphatic fertilizers was 240,300, 267,400 and 316,000 nutrient tons in these sectors, respectively.

Since 1960, the consumption of fertilizers has been given a high priority. In that year, less than 300,000 tons of chemical fertilizers were being used. As a result of the Government's policy of low, subsidized prices for fertilizers, by 1970 total consumption had risen to around 6.5 million tons, and by 1982 it had reached 8 million tons, of which 21 percent was nitrogenous and 17 percent P₂O₅. Despite this increase, the fertilizer use per hectare is still very low compared with other countries, as shown in Table 3.
### Table 2: ANNUAL N AND P2O5 CAPACITY OF THE FERTILIZER INDUSTRY, 1982
('000 nutrient tons)

<table>
<thead>
<tr>
<th>Capacity</th>
<th>N</th>
<th>P2O5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I. Public Sector</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. AZOT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kutahya I</td>
<td>22.7</td>
<td>-</td>
</tr>
<tr>
<td>Kutahya II</td>
<td>88.0</td>
<td>-</td>
</tr>
<tr>
<td>Samsun I</td>
<td>-</td>
<td>99.0</td>
</tr>
<tr>
<td>Samsun II</td>
<td>40.9</td>
<td>104.5</td>
</tr>
<tr>
<td>Elazig</td>
<td>-</td>
<td>39.5</td>
</tr>
<tr>
<td>Gemlik</td>
<td>154.4</td>
<td>-</td>
</tr>
<tr>
<td>Sub-total</td>
<td>306.0</td>
<td>243.0</td>
</tr>
<tr>
<td>B. IGSAS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tutunciftlik</td>
<td>235.3</td>
<td>-</td>
</tr>
<tr>
<td>C. PETKİM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yarımca</td>
<td>21.0</td>
<td>-</td>
</tr>
<tr>
<td>D. IRON &amp; STEEL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Karabuk</td>
<td>1.8</td>
<td>4.0</td>
</tr>
<tr>
<td>Iskenderum</td>
<td>2.5</td>
<td>-</td>
</tr>
<tr>
<td>Sub-total</td>
<td>4.3</td>
<td>4.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>566.6</td>
<td>247.0</td>
</tr>
</tbody>
</table>

| **II. Joint Sector** |     |      |
| A. GUBRE  |     |      |
| Yarmica I | -   | 90.0 |
| Yarmica II | 40.0 | 40.0 |
| SartisekI | -   | 92.0 |
| Sub-total | 40.0 | 222.0 |
| B. AKDENIZ |     |      |
| Mersin    | 181.0 | 68.1 |
| **Total** | 221.0 | 290.1 |

| **III. Private Sector** |     |      |
| A. BAGFAS  |     |      |
| Bandırma I | -   | 73.6 |
| Bandırma II | 97.0 | 112.0 |
| Sub-total | 97.0 | 185.6 |
| B. EGE    |     |      |
| Foca      | 61.3 | 61.3 |
| C. TOROS  |     |      |
| Ceyhan   | 66.0 | 66.0 |
| **Total** | 224.3 | 312.9 |

| **IV. Gross Total** |     |      |
| 1,011.9 | 850.0 |

| **Of which NPK** |     |      |
| 167.3 | - |

| **V. Local Urea Used in NPK** |     |      |
| 83.6 | - |

| **VI. Net Total** |     |      |
| 928.3 | 850.0 |

Source: State Planning Organization.
Table 3: CONSUMPTION OF FERTILIZERS PER HA. OF AGRICULTURAL AREA (A), ARABLE LAND AND PERMANENT CROPS (B), AND PER CAPITA (C), 1980
(100 grams N, P\textsubscript{2}O\textsubscript{5}, K\textsubscript{2}O)

<table>
<thead>
<tr>
<th>Countries</th>
<th>(A)</th>
<th>(B)</th>
<th>(C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egypt</td>
<td>2,324</td>
<td>2,324</td>
<td>158</td>
</tr>
<tr>
<td>Libya</td>
<td>52</td>
<td>374</td>
<td>261</td>
</tr>
<tr>
<td>Mexico</td>
<td>123</td>
<td>517</td>
<td>173</td>
</tr>
<tr>
<td>US</td>
<td>497</td>
<td>1,116</td>
<td>934</td>
</tr>
<tr>
<td>Argentina</td>
<td>6</td>
<td>32</td>
<td>42</td>
</tr>
<tr>
<td>Brazil</td>
<td>190</td>
<td>678</td>
<td>343</td>
</tr>
<tr>
<td>Iran</td>
<td>95</td>
<td>359</td>
<td>150</td>
</tr>
<tr>
<td>Israel</td>
<td>667</td>
<td>1,987</td>
<td>212</td>
</tr>
<tr>
<td>Japan</td>
<td>3,325</td>
<td>3,721</td>
<td>156</td>
</tr>
<tr>
<td>Pakistan</td>
<td>398</td>
<td>495</td>
<td>116</td>
</tr>
<tr>
<td>Greece</td>
<td>574</td>
<td>1,342</td>
<td>549</td>
</tr>
<tr>
<td>Italy</td>
<td>1,205</td>
<td>1,701</td>
<td>372</td>
</tr>
<tr>
<td>Turkey</td>
<td>307</td>
<td>412</td>
<td>259</td>
</tr>
</tbody>
</table>


Marketing and Distribution

Until 1973, no less than 12 Government agencies plus a number of private sector organizations were engaged in the distribution of fertilizers. This multiplicity of distributors caused major problems, primarily because of uncoordinated programs. Consequently, in 1973 the Government enacted a decree giving DONATIM a virtual monopoly over the import, procurement and distribution of fertilizers. SEKER, however, was given limited responsibility for supplying fertilizers to the sugarbeet industry. In effect, DONATIM received about 90 percent of the total fertilizer market, SEKER 10 percent.

DONATIM was established in 1943 and became a State Economic Enterprise in 1944. Under the provisions of a 1973 decree, it is charged with the procurement and distribution of all inputs into the production of crops, including fertilizers. DONATIM's headquarters are in Ankara; it has 25 regional offices and 419 branches for marketing.

DONATIM's marketing operations involve the transport of fertilizers from local factories or ports of entry to a network of 958 depots throughout the country. The policy is to have at least one depot in most administrative districts, i.e., at the sub-provincial level, although many districts have more than one. Of the total 958 depots, DONATIM actually owns 339 and rents 619. Total storage capacity is about 2.1 million tons, of which DONATIM's own depots account for 1.8 million.
DONATIM's depots operate in two ways. First, they make direct sales to farmers. Second, they act as supply (warehouse) points for the retail marketing organizations, primarily the Agricultural Credit Co-operatives. As a measure of the relative importance of the two operations, in 1981, direct sales to farmers accounted for 49 percent of total sales, while supplies to DONATIM's retail organizations accounted for 51 percent.

DONATIM's depots constitute only a limited number of sales outlets, most of which are concentrated at district headquarters and other towns. To make fertilizers more readily accessible, DONATIM also relies on other retail sales networks. In 1981, it had 3,530 sales outlets comprised of 2,100 Agricultural Credit Co-operatives, 1,331 Agricultural Sales Co-operatives, 93 Chamber of Agricultural branches, and six branches of the Technical Agricultural Directorate. The first two categories are fairly well-distributed geographically, with concentrations more or less in line with demand across and within provinces.

DONATIM pays for the fertilizers from local plants and for imports with funds from the Government. It purchases fertilizers at the ex-factory prices determined by the Government or the landed cost in the case of imports. To that is added the marketing costs involved in getting the fertilizers to the retail sales outlets; those costs include administrative overhead. Any profit or loss is absorbed or reimbursed by the Government. The amount is determined by deducting DONATIM's costs (product and marketing) from its sales revenue. It is supposed to make payments to local plants within 20 days; if there is a delay, an annual interest rate of 40 percent is to be applied. DONATIM sells to the retail organizations for cash or credit, although the latter must be backed by a guarantee issued by the Agricultural Bank or some other form of security. It sells to its retailers at the Government's retail prices, which include delivery and unloading at the retailers' warehouses. DONATIM offers discounts to its retailers--0.9 to 1 percent for pre-season deliveries, 0.46 to 0.5 percent for in-season deliveries. These discounts, being low, do not provide a strong incentive.

In 1977, DONATIM's product and marketing costs were 3.9 Turkish lira (TL) billion; in 1981, they increased to TL 63.9 billion. Of the 1981 cost, 56 percent was the result of high fertilizer costs (TL 35.87 billion), 46 percent, marketing expenses (TL 28 billion). In that year, DONATIM distributed 3.1 million tons. Thus the unit marketing cost was TL 9.06/ton, very high compared to the marketing costs in other countries. However, about 66 percent of this cost was attributable to the high financing charges; when those are left out, the marketing costs were reasonable.

Turkey's marketing and distribution system could be improved by opening up the market to fertilizer producers. This should have two results. One would be to encourage greater capacity utilization, as producers will want to sell more fertilizers to make more profit. The second should be to lower marketing costs. From 1980 to 1982, DONATIM's marketing costs were, as noted, quite high, principally because of the high financing costs, i.e., as a result of the interest DONATIM had to pay on
late payments to producers. Having the producers involved in marketing could decrease that cost. Moreover, to enhance their profits, the producers would seek to reduce other costs such as transport, handling and warehousing and to improve services to attract customers. They would also have an incentive to improve the distribution system and to undertake promotional activities.

One way to reduce transportation costs is to rationalize production relative to demand, ensuring that a particular area's needs are met by the nearest factories. Such a plan might require measures to ensure that a monopoly did not develop in any area, perhaps through the use of specified retail pricing. The Government could establish retail prices (ex-factory plus marketing costs) for each province, and any producer able to sell at that price could market its products in that area.

Under the recommended distribution network shown in Figure 1, in addition to DONATIM, the fertilizer producers would develop their own marketing organizations. As a whole, the system could involve one central organization with field offices at the provincial level. Producers could supplement the existing retail network, which now consists mainly of the cooperative organizations, with private retailers.

To ensure a smoother transition to this system, the Government would need to plan distribution carefully to ensure adequate availability throughout the country while avoiding excessive stocks at DONATIM warehouses. Distribution policy could be set by the Government in consultation with the producers and DONATIM. Based on detailed estimates of demand by province, these groups could produce half-yearly plans for supply by province.

Improvements can also be made in fertilizer storage. Present capacity appears to be adequate to meet storage needs up to 1992, with some small additions. Because of the cost of building new storage facilities, producers should consider using DONATIM's depots.

To assist in implementing these changes and to enhance coordination and cooperation, it would be useful to set up a fertilizer association of producers and marketing agencies. The association should be independent of the Government. Policy would be set by a board of directors made up of representatives of DONATIM, SEKER and the producers. Its functions would include coordinating with the Government on production, importation and consumption, and cooperating with the Government on the formation of ex-factory and retail prices.

III. FERTILIZER PRICING

Ex-Factory Pricing

Prior to the second half of 1980, Turkey had used basically two methods to determine ex-factory prices: cost plus profit and import
Figure 1:

Recommended Distribution System
pricing. A cost plus system was used until the second half of 1975, but was found to provide no incentive for integrating plants and for higher capacity utilization. In response, the Government tried a modified system in the second half of 1975, but it, too, proved unsatisfactory. Beginning in 1980, the Government introduced another system based on c.i.f. import prices. However, it was never actually applied because of the complications caused by the fluctuations in international prices and the inability of some plants to compete with world prices, given their outdated technology and less than optimum capacities.

The current pricing system, introduced in July 1980, is weighted in favor of foreign exchange savings. The ex-factory prices for each fertilizer plant are determined every six months based on the average c.i.f. dollar price of comparable products imported by DONATIM during the previous six months. The formula is:

\[ F = [A - (B + C)] P + D + E \]

Where

- \( F \) = The ex-factory price (TL/ton),
- \( A \) = c.i.f. import price for comparable products (US$/ton),
- \( B \) = The dollar value of direct imports of raw materials and/or intermediate products per ton of fertilizer produced (US$/ton),
- \( P \) = The shadow exchange rate,
- \( D \) = Value (TL), at the prevailing exchange rate, of imports of raw materials and/or intermediate products per ton of fertilizer produced,
- \( E \) = Value (TL) of local materials consumed per ton of fertilizer produced (TL/ton),
- \( C \) = US$ value of \( E \) (per ton) at the prevailing exchange rate.

These variables are further defined as follows:

- \( A \), the c.i.f. price of fertilizers, or the value characterizing the average import price in the six-month period, is determined by DONATIM for each fertilizer product whether it is imported in that period or not. Starting in 1981, the formula was modified to dampen the effects of falling international fertilizer prices by lagging the import prices used in the calculation by six months to a year. This was done to protect manufacturers from the sharp cyclical movements in international prices.

- \( B \), the dollar value of direct imports of raw materials and/or intermediate products per ton of fertilizer produced, is calculated on the
basis of the price of inventories and the c.i.f. import price in the period.

C, the dollar value of local raw materials and/or intermediates, is calculated as follows:

- If the plant has imported the same raw materials, the average price of the imports is used;
- If the same materials have been imported by other plants but not by the plant in question, the average import price of the other companies is used;
- If there are no imports in the period, c.i.f. world prices are used;
- Inventories at the beginning of the six-month periods are taken into consideration.

P, the shadow exchange rate, is determined by the Money Credit Committee of the Treasury.

D, the value of imported raw materials, is calculated as follows:

- Foreign exchange rates at the date of clearing customs are used as the basis for valuing raw materials both in inventories and from actual imports in the period under consideration;
- If a company has not cleared its materials through customs within 90 days after importation, the dollar rate on the 91st day is used;
- If some materials have not cleared customs at the end of the period, they will be valued at the exchange rate at the end of the period. (This criterion was valid during the first half of 1981.)

E, the TL value of local materials per ton of fertilizer produced, is calculated based on the inventories at the beginning of the period. Producers confirm the purchase prices by presenting invoices or protocols to the Ministry of Agriculture and Forestry. If the Ministry finds that the prices are not realistic, it will calculate new ones using the same formula as for fertilizer products.

Evaluation of the System

The prior pricing systems, which were based on cost plus profit and import prices, did not encourage producers to minimize costs or to integrate plants and use local raw materials. The current pricing system addresses both these issues. It encourages the industry to reduce its dependence on imports by providing producers an incentive to invest in
facilities that can use local raw materials and manufacture intermediate products to increase the domestic value added.

Nevertheless, the system has two weaknesses involving the c.i.f. prices (which fluctuate widely) and the determination of the shadow exchange rate. Producers are not provided with clear signals ahead of time, since the c.i.f. prices and shadow exchange rate are not determined according to clear standards.

Recommended Modifications

Under a World Bank-financed study, TUMAS (Turkish Engineering, Consulting and Contracting Co.) has examined more systematic methods for determining the c.i.f. prices and shadow exchange rates. TUMAS, in consultation with the State Planning Organization, has developed the following approaches to overcome the weaknesses in the current fertilizer pricing system.

Determining Long-Term Trend Prices. The approach TUMAS recommends is to use five-year averages of international prices, since the international fertilizer supply and demand balance fluctuates at approximately five-year intervals. As can be seen from Figures 2a, 2b and 2c, the curves obtained by taking the average of the past five years show a reasonable price trend for each fertilizer product.

It turns out that the five-year c.i.f. average prices reported by DONATIM correspond quite closely to the international price curves. There are some fluctuations in the five-year average c.i.f. prices reported by DONATIM, but they are insignificant. As such, it is recommended that DONATIM's average c.i.f. prices for the prior five years be used in the formula to establish the ex-factory prices.

TUMAS is also investigating the use of the f.o.t. prices of the major fertilizer producers instead of the c.i.f. prices reported by DONATIM.

Calculating the Shadow Exchange Rate. Currently, the estimates of the shadow exchange rate are based on weighted averages of the import tariffs and export subsidies, the weights being given by the relative importance of traded and non-traded goods in production and consumption.
Figure 2a:
UREA F.O.B. (Europe) Prices

Years

1973 '74 '75 '76 '77 '78 '79 '80 '81 '82 '83

US$/ton

300

200

100

0

5-Year Average
Figure 2b:
TSP F.O.B. (U.S. Gulf) Prices

World Bank—26656
Figure 2c:
DAP F.O.B. (U.S. Gulf) Prices

Years
1973 '74 '75 '76 '77 '78 '79 '80 '81 '82 '83

US$/ton
300
200
100
0

World Bank—26657
As an approximation, the weights may be based on the shares of imports and exports in total trade. A simple formula for estimating the shadow exchange rate or free trade exchange rate is:

\[
\begin{align*}
\frac{\text{Official Exchange Rate}}{\text{Shadow Exchange Rate}} &= \frac{X_e + M_n}{X_e (1-t_x) + M_n (1+t_m)} \\
\end{align*}
\]

where

- \(X\) = f.o.b. value of exports
- \(M\) = c.i.f. value of imports
- \(e\) = Elasticity of export supply
- \(n\) = Elasticity of import demand
- \(t_x\) = Average export tax (if there is a subsidy, the sign will be positive)
- \(t_m\) = Average import tax.

Research on elasticities indicates that the ratio of the official to the shadow exchange rate is not very sensitive to different assumptions about elasticities, and their removal from the formula will not affect the result very much.

**Retail Pricing**

The Government also sets the retail prices for fertilizers, taking into account the cost/benefit to the farmer, including the relative prices of fertilizers and crops. The overriding concern in recent years has been to keep the prices of agricultural inputs, including fertilizers, low enough to encourage increased farm production. As a result, fertilizer prices were low from the mid-1960s to the early 1970s. There was a large increase in prices in 1974 following the quadrupling of international fertilizer prices, but in 1975 the Government reduced them sharply, mainly to reverse the slump in consumption, and held them at that level until 1979. However, in 1980, to reduce the burden of the fertilizer subsidy on the budget, the Government instituted two increases in retail prices.

**IV. THE FERTILIZER SUBSIDY**

As noted, in recent years the fertilizer subsidy has become a major issue. In 1981 it amounted to TL 61.7 million, broken down as follows (see Figure 3):
Figure 3:
Subsidies Relative to Import Prices
1977-82

1 Using earlier former prices.
2 Using revised former prices.
3 Using the first half ex-factory prices for 1982.
That figure is equal to about 10 percent of the Government's current expenditures. DONATIM pays the subsidy except that relating to fertilizers used for sugarbeets, which is paid by SEKER.

It would be useful to calculate the subsidies to producers and consumers separately, as one policy alternative is to abolish the present method of intervention and allow free trade in fertilizers, but it is difficult to do so, as DONATIM holds considerable stocks of fertilizers. However, the cost of fertilizers consumed at 1981 import prices (Table 4) can be compared with the prices paid actually by farmers. In relation to the import prices, the cost of the subsidy to farmers was TL 38.1 billion in 1981, as shown in Table 4.

<table>
<thead>
<tr>
<th>Product</th>
<th>Consumption ('000 tons)</th>
<th>Prices (in '000 TL/ton)</th>
<th>Total costs (TL bn)</th>
<th>Total farmer subsidy (TL bn)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>c.i.f. Imports</td>
<td>At c.i.f.</td>
<td>At farmer prices</td>
</tr>
<tr>
<td>AS</td>
<td>441</td>
<td>14.8</td>
<td>6.0</td>
<td>6.5</td>
</tr>
<tr>
<td>AN</td>
<td>1,092</td>
<td>18.2</td>
<td>7.5</td>
<td>19.9</td>
</tr>
<tr>
<td>Urea</td>
<td>426</td>
<td>22.4</td>
<td>14.5</td>
<td>9.5</td>
</tr>
<tr>
<td>TSP</td>
<td>374</td>
<td>25.4</td>
<td>12.5</td>
<td>9.5</td>
</tr>
<tr>
<td>DAP</td>
<td>497</td>
<td>35.0</td>
<td>20.0</td>
<td>17.4</td>
</tr>
<tr>
<td>NPK</td>
<td>536</td>
<td>24.0</td>
<td>14.0</td>
<td>12.9</td>
</tr>
<tr>
<td>Others</td>
<td>114</td>
<td>21.1</td>
<td>7.9</td>
<td>2.4</td>
</tr>
<tr>
<td>Total</td>
<td>3,480</td>
<td></td>
<td>78.1</td>
<td>40.0</td>
</tr>
</tbody>
</table>

\[a/\text{Average.}\]

Source: State Planning Organization.

As to producers, in the same year ex-factory prices were about 21 percent above import prices (Table 5). This is partly because world fertilizer prices continued to be depressed in 1981.
Table 5: COMPARISON OF EX-FACTORY AND IMPORT PRICES

<table>
<thead>
<tr>
<th>Product</th>
<th>Ex-factory price (TL '000/ton)</th>
<th>C.i.f. import price (TL '000/ton)</th>
<th>Ex-factory price as a percentage of import price (c.i.f.) in 1981 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS</td>
<td>18.2</td>
<td>14.8</td>
<td>123</td>
</tr>
<tr>
<td>AN</td>
<td>20.7</td>
<td>18.2</td>
<td>114</td>
</tr>
<tr>
<td>Urea</td>
<td>33.2</td>
<td>22.4</td>
<td>148</td>
</tr>
<tr>
<td>TSP</td>
<td>33.1</td>
<td>25.4</td>
<td>130</td>
</tr>
<tr>
<td>DAP</td>
<td>36.6</td>
<td>35.0</td>
<td>105</td>
</tr>
<tr>
<td>NPK</td>
<td>34.1</td>
<td>24.0</td>
<td>142</td>
</tr>
<tr>
<td>Others</td>
<td>18.6</td>
<td>21.1</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td>27.8a/</td>
<td>23 a/</td>
<td>121</td>
</tr>
</tbody>
</table>

a/ Average.

Source: State Planning Organization.

There is considerable dispute as to whether the protection afforded the fertilizer industry in Turkey is justified. Since 1977, 6 of the 19 fertilizer plants have not been competitive. The main reasons are: the small size of operations; old technology; and low capacity utilization because of technological bottlenecks. However, capacity utilization has been increasing: from 33.8 percent in 1979 to 43.4 percent in 1980 and 65.6 percent in 1981. It is expected to rise further--to over 80 percent--with the completion of the two projects underway for the rehabilitation of selected viable plants.

Projects also include some new investments to increase productivity and energy efficiency. The World Bank is providing $200 million for this work, which is scheduled to be completed in 1986. Even after the completion of these projects, four small-size plants using old technology may not be competitive unless world fertilizer prices increase substantially from the current depressed levels.
Chapter 16

EX-FACTORY PRICING IN TURKEY

Erhan Oner,
President
TOROS Fertilizer and Chemical Industry Co., Inc.

I. INTRODUCTION

Turkey is primarily an agricultural country. Given the relatively high rate of population growth and strong desire to expand the traditional agricultural export base, Turkey has been increasing its agricultural output at a high rate.

Fulfillment of this key objective requires very close attention to the fertilizer sector, and the Government determines the ex-factory prices of fertilizers to encourage production. While it has applied different pricing methods, all have been based more or less on the cost plus principle. In addition, the Government also sets the farmgate prices of fertilizers, which are sold to farmers at subsidized prices. This policy has, however, resulted in a heavy burden on the budget.

The ex-factory prices of fertilizers are set long after production, a situation that leaves producers operating under uncertainty. Further, the present pricing formula is not based on concrete principles, and producers are not in a position to forecast their year-end financial position. The result has been a slowdown or postponement of rehabilitation and/or expansion projects.

This paper proposes a new basis for determining the two key variables of the current ex-factory pricing formula, the c.i.f. import price and the shadow exchange rate, and suggests some measures to overcome the ambiguity of the pricing system. To summarize, under the proposed system, ex-factory prices could be determined in the following manner:

1. C.i.f. import prices would be adjusted to arrive at delivered prices comparable to the local f.o.t. ex-factory prices. Such prices should be determined quarterly either by tender or by negotiation between concerned parties;

2. The ratio of the shadow exchange rate to the average rate of exchange should be fixed in a manner similar to the export reimbursements applied to exporters in general; and

Note: The views expressed in this paper are the author's own and do not necessarily reflect those of other fertilizer producers.
(3) Payments to producers should be made promptly so as to eliminate the heavy costs of bridge financing, which at present are not covered by the formula.

These modifications will allow DONATIM, the government-owned distributor, to buy its fertilizers at competitive international prices. As such, the need for subsidies to producers would be eliminated.

II. THE FERTILIZER INDUSTRY

Production, Consumption and Capacity

Fertilizer production started on a small-scale in Turkey in 1939 at the Karabuk Iron and Steel Works factory with the production of ammonium sulphate as a byproduct. However, not until the launching of the Development Plan in the 1960s did production go beyond 62,000 nutrient tons. Since then, the pace has been rapid, with production reaching almost 1,800,000 nutrient tons in 1981. Today, seven companies produce fertilizers exclusively. Of these, two belong to the joint sector, two are in the public sector and three are privately-owned.

In 1982, the domestic production capacity of nitrogenous fertilizers was 569,700 nutrient tons in the public sector, 221,200 nutrient tons in the joint sector and 246,100 nutrient tons in the private sector. For phosphatic fertilizers, the capacity breakdown by sector was 240,300, 267,400 and 316,000 nutrient tons, respectively.

Fertilizer consumption in Turkey is low compared with the developed countries (Table 1). The task of increasing fertilizer consumption is affected by many factors such as the ratio of fertilized land to total arable land, irrigation and crops planted, as well as by the relationship between crop and fertilizer prices.

One of the main reasons for past increases in fertilizer consumption has been increases in fertilized areas: the ratio of fertilized to total arable land rose from 33 percent to 65 percent between 1973 and 1981. Similarly, the importance of irrigation to greater agricultural production is well-known. As the product yield rises with irrigation, fertilizer consumption also rises. Today, however, only about 10 percent of the agricultural land is irrigated, and production depends mainly on rainfall. Present plans envisage that the percentage of land that will be irrigated will rise to 40 percent within the next 10 years.

During the last 10 years, about 55 percent of the total fertilizer consumption has been accounted for by nitrogenous fertilizers, 42 percent by phosphatic fertilizers and 3 percent by potash fertilizers. The general trend has been a higher rate of increase in the consumption of nitrogenous fertilizers than phosphatic and potash fertilizers.
Table 1: FERTILIZER NUTRIENT
CONSUMPTION PER HECTARE OF ARABLE LAND

<table>
<thead>
<tr>
<th>Country</th>
<th>Consumption (kg./ha.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Netherlands</td>
<td>789</td>
</tr>
<tr>
<td>Belgium</td>
<td>499</td>
</tr>
<tr>
<td>Germany, F.R.</td>
<td>471</td>
</tr>
<tr>
<td>France</td>
<td>300</td>
</tr>
<tr>
<td>England</td>
<td>294</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>198</td>
</tr>
<tr>
<td>Italy</td>
<td>170</td>
</tr>
<tr>
<td>Greece</td>
<td>134</td>
</tr>
<tr>
<td>USSR</td>
<td>81</td>
</tr>
<tr>
<td>Turkey</td>
<td>66</td>
</tr>
</tbody>
</table>

Source: FAO and State Planning Organization.

There was a sudden decrease in fertilizer consumption in 1980. The main reason was a sharp increase in fertilizer prices, ranging from 66-141 percent, while crop prices increased by only 21-95 percent. However, subsequently there has been a gradual rise in fertilizer consumption, which by 1982 reached the peak level of 1979.

The Fertilizer Marketing System

Turkey uses a monopoly system for the procurement and distribution of fertilizers. They are obtained and distributed by two public sector agencies, Turkiye Zirai Donatim Kurumu (DONATIM) and Turkiye Seker Fabrikalari A.S. (SEKER). This system is designed to facilitate the administration of the fertilizer subsidy system and to ensure orderly distribution of fertilizers over as wide an area as possible. Both agencies purchase locally produced fertilizers from producers, while DONATIM has additional responsibility for imports. DONATIM sells about 90 percent of all fertilizers distributed, while SEKER accounts for the remaining 10 percent, which go primarily to sugarbeet farmers.

DONATIM's sales to retail organizations are made for cash or credit. Credit is for a maximum 12-month period, with the initial three months interest-free. Sales to farmers by retail organizations are partly for cash and partly for credit for 6-12 months. Farmers can also get fertilizer credits with low interest rates from the Agricultural Bank. SEKER supplies its fertilizers to farmers on credit, which is recovered from the proceeds of the sale of the next sugarbeet crop sold to SEKER. In all, two-thirds of fertilizers sold to farmers are on credit.

DONATIM's present storage capacity is about 2.15 million tons. Although its overall storage capacity is adequate (equal to 38 percent of
the fertilizers consumed in 1982), there is some imbalance in the distribution of such facilities in the consuming regions.

III. EX-FACTORY FERTILIZER PRICING POLICIES

Early Pricing Systems

In the early years, when fertilizer consumption was low and most production units belonged to the State, fixing the ex-factory prices was not much of a problem. However, in later years, the role of the private sector in fertilizer production increased, and a wider range of fertilizers came to be produced. This situation created problems in establishing ex-factory prices.

Basically, two different systems have been used to fix ex-factory prices since the 1960s: cost plus profit and import parity. Between 1962 and 1975, ex-factory prices were fixed by the Ministries of Commerce, Agriculture, and Industry and Technology after reviewing the costs of each producer and adding a 10 percent profit to the calculated costs. However, the basic principle underlying this system was the same price for the same product. As such, the calculated prices had to be reconciled through negotiations with all manufacturers of each product until one price was agreed upon by everyone. Thus, although the system was allegedly cost plus profit, in fact the final price was established by bargaining between industry and the Government.

In 1975, a new system was introduced by decree, whereby the ex-factory price was to be established jointly by producers and distributors at six-month intervals. The production costs of different plants over each six-month period were taken as the basis, with each fertilizer type receiving a single price based on the average domestic production cost plus a percentage profit margin. To resolve disagreements, the decree set up a Fertilizer Committee with members from the State Planning Organization, the Ministries of Agriculture, Finance, Industry and Technology, the distribution organizations (DONATIM and SEKER), the Agricultural Bank, and the state-owned producer, AZOT. This committee formed a sub-committee whose job was to calculate the ex-factory prices based on the average production cost of producers. The sub-committee's suggested prices were taken into account by the committee when fixing prices.

Problems arose because of the disparities in actual production costs incurred by different plants producing the same product, disparities caused by different technologies and the degree of reliance on local raw materials. As a result, in 1976 a new decree was issued. The price mechanism was kept the same, but the committee was abolished, and the Ministry of Agriculture was designated as the "approval authority" and, in cases of disagreement, the "arbitrator." As expected, in practice agreement between producers and distributors was rarely reached. The main reason was that to avoid criticism over the amount of subsidy, DONATIM always opted to pass the decision to the ministry.
Given these circumstances, the ministry formed a commission that included the Ministries of Finance, Industry and Technology, DONATIM and SEKER. The commission's job was to establish ex-factory prices based on the following guidelines:

- Prices would be fixed at six-month intervals.

- In the cost calculations, standard costs would be used instead of actual costs. The price would be fixed for the first half of the year on the basis of anticipated standard costs, and a reasonable profit margin would be added. In estimating the anticipated standard costs, actual costs in the previous periods would be reviewed, and certain adjustments would be made, including adjustments for anticipated developments in the ensuing period.

- In calculating the standard cost, 70 percent capacity utilization would be used as the base.

- To compensate for the difficulty of producing nitrogenous fertilizers compared to phosphatic fertilizers, a profit margin of 15 percent would be allowed for nitrogenous fertilizer producers, while phosphatic fertilizer producers would get 10 percent.

- Under this system, instead of the same price for the same product, the principle of the same profit margin for the same product would be applied, and the ex-factory prices for the same product could be different for different producers.

Again, while this system was based on the principle of a freely established price, in fact it was a modified cost plus system.

This system was used until 1980. At that time, a new decree introduced a totally different approach to ex-factory pricing. The ex-factory price of a given fertilizer would be calculated on the basis of the c.i.f. import price plus a 5 percent margin (in some cases the margin might be increased to 15 percent). The aim of this system was to bring the ex-factory prices of local producers to a level competitive with international prices. Because of the wide gap between the c.i.f. import prices and the costs to most of the producers, this system was never applied.

**Current Pricing System**

In the second half of 1980, a new decree changed the ex-factory pricing system once again. Under the current system, the ex-factory prices for each fertilizer plant are determined by product every six months based on the average c.i.f. dollar price of comparable products imported during the previous six months. The c.i.f. dollar value of actual direct imports of raw materials and/or intermediate products, as well as the dollar value (at the official exchange rate) of the total raw materials and/or
intermediate products used per ton of fertilizer produced by each factory, are deducted from the c.i.f. import prices of comparable fertilizer products, and the balance in dollars is valued at a shadow exchange rate established by the Government. To it is added the dollar value expressed in Turkish lira (TL) (at the average official exchange rate during the last six-month period) of the imported raw materials and/or intermediate products, as well as the TL value of local raw materials and/or intermediate products used per ton of fertilizer produced. Based on the sum of all those items, the ex-factory product price in TL is determined for each plant.

Formally, the formula can be expressed as follows:

\[ F = [A-(B+C)]P+D+E \]

where \( F \) = Ex-factory price (TL/ton).

\( A \) = c.i.f. import price of comparable products (US$/ton).

\( P \) = Shadow exchange rate determined by the Money and Credit Committee.

\( B \) = US$ value of direct raw material and/or intermediate imports per ton of fertilizer produced (US$/ton), calculated on the basis of the price of inventories and c.i.f. price of imports realized by the manufacturer in the period.

\( E \) = TL value of local raw materials and/or intermediates per ton of fertilizer produced (TL/ton), calculated considering the manufacturer's inventories at the beginning of the period and actual purchases (documented by invoices).

\( D \) = TL value of \( B \) (TL/ton), i.e., TL equivalent value of imported raw materials or intermediates per ton of fertilizer produced. This is calculated using the actual exchange rate at the date of clearing from customs. (Materials not cleared from customs at the end of the six-month period, or within 90 days after importation, are evaluated at the exchange rate as of, respectively, the end of the period or the 91st day.)

\( C \) = US$ value (at the official exchange rate) of domestic raw materials and/or intermediates accounted for in \( E \). This is estimated on the basis of actual imports (either by the same company or of similar materials by another domestic producer) during the corresponding six-month period or, if there was no import during the period, on the basis of c.i.f. world prices. Inventories at the beginning of the six-month period are taken into consideration.
Evaluation of the Pricing Formula

The current formula aims to reduce the industry's dependence on imports by providing an incentive for local producers to invest in facilities that can use both local raw materials and intermediate products to increase the domestic value added. Further, it provides incentives for firms to invest in improved equipment, training, etc., to raise productivity. The question is whether this system, in fact, yields those results.

A starting point in addressing that question is nitrogenous fertilizers. Natural gas and crude oil-based petroleum products (e.g., fuel oil) are the common feedstocks for nitrogenous fertilizer production. Turkey's local crude oil production accounts for barely one-fifth of its annual consumption. Although natural gas reserves have been found in Thrace, a serious debate is going on as to whether it should be used for power generation or as raw material for fertilizers. The other locally available raw material for the production of nitrogenous fertilizers is lignite. Setting up a lignite-based plant can hardly be achieved through the incentives of the shadow exchange rate, considering the high capital cost and operational complexity of such plants. Therefore, as far as nitrogenous fertilizers are concerned, the formula does not encourage the use of local raw materials.

As for phosphatic fertilizers, the basic raw materials—phosphate rock and sulfur (or pyrites)—of acceptable quality are not yet readily available. It would take large investments over some years to develop the infrastructure necessary even to start exploiting such reserves. Moreover, the traditional suppliers of phosphate rock in the international market are setting up large acid-producing capacities to export acid instead of the rock. It is obvious that they would not encourage the purchase of rock in lieu of acid. Therefore, integrated production starting from basic raw materials is not feasible, regardless of the shadow exchange rate incentives. In other words, since Turkey lacks the essential raw materials for the manufacture of fertilizers, one of the aims of the formula, i.e., reducing the industry's dependence on imports, does not appear to be achievable.

Another benefit cited in support of the formula is that it induces new investment in improved equipment, training, etc., to improve the productivity of plants. While the underlying principles and aims of the formula may seem very appealing, in reality they do not take into account many factors that affect the profitability of different producers. Under this formula, for example, a very old plant with no more depreciation and financial charges, even while operating at a very low capacity, is able to earn an attractive profit, while a new plant operating efficiently at a very high capacity, but with high depreciation and financial charges, is penalized with a very low profit margin. Therefore, many producers are seriously considering reducing or postponing their investment plans for modernization and/or new projects.
One major shortcoming in the pricing formula is that the Government establishes the two major parameters of the formula—the c.i.f. import price and the shadow exchange rate—with some degree of arbitrariness and without strictly following concrete principles. Further, the ex-factory price is usually fixed with a lag of 6-12 months. Another major problem faced by producers is the rising receivables of DONATIM, a situation that forces producers to resort to local short-term borrowing at very high rates for working capital. In this context, one company has already reduced its deliveries to the local market and has started exporting.

IV. SUBSIDIES TO FARMERS

Another controversial issue is the subsidy. Fertilizers are sold at subsidized prices to farmers by the two marketing agencies, DONATIM and SEKER (Table 2). These two agencies purchase fertilizers at f.o.t. (free on truck) ex-factory prices or at c.i.f. import prices in the case of imports. The difference between the total cost to the marketing agencies and their sales revenues is called the "duty loss"; it is covered by the Government from the Price Stabilization Fund. Because the Government has continuously been late in reimbursing the two agencies, they have had to borrow from the State-owned Agricultural Bank. The impact is severe—the interest paid by DONATIM accounts for about 65 percent of total marketing costs.

Table 2: FERTILIZER SUBSIDIES IN TURKEY, 1974-82

<table>
<thead>
<tr>
<th>Years</th>
<th>TL billion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1974</td>
<td>1.0</td>
</tr>
<tr>
<td>1975</td>
<td>2.6</td>
</tr>
<tr>
<td>1976</td>
<td>3.7</td>
</tr>
<tr>
<td>1977</td>
<td>4.5</td>
</tr>
<tr>
<td>1978</td>
<td>11.4</td>
</tr>
<tr>
<td>1979</td>
<td>24.6</td>
</tr>
<tr>
<td>1980</td>
<td>38.1</td>
</tr>
<tr>
<td>1981</td>
<td>68.5</td>
</tr>
<tr>
<td>1982</td>
<td>73.0</td>
</tr>
<tr>
<td>1983 (est.)</td>
<td>114.0</td>
</tr>
</tbody>
</table>

Source: State Planning Organization.

In general, it is claimed that part of the subsidy goes to the producers, since their ex-factory prices are higher than the currently depressed c.i.f. import prices by about 30 percent. It is also alleged
that producers account for about 20-25 percent of the total amount of the subsidies. However, a question that must be asked is whether it is valid to compare f.o.t. ex-factory prices with c.i.f. import prices? The answer is no; this comparison is not appropriate, as the free world market prices do not include these elements of the f.o.t. ex-factory prices:

- Port and unloading expenses from vessels to trucks
- Wastage
- Letter of credit and insurance expenses
- Storage and stock-keeping expenses at the producer's premises
- The interest burden carried by producers on late payments by DONATIM
- The variation in the c.i.f. import price, depending on whether imports are done in large or limited quantities.

The last item is not easy to estimate as accurately as the others. Assume, however, that instead of importing the balance between local consumption and production as is done today, the total requirement were supplied through imports. In such a situation, the c.i.f. import prices for large tonnage imports higher and port congestion that could result from such large-scale imports could lead to heavy shipping demurrages.

The above-mentioned items invalidate the comparison between f.o.t. ex-factory prices and c.i.f. import prices. If estimated properly, the above items could account for a 25-30 percent difference between the c.i.f. import prices and the f.o.t. ex-factory prices under today's conditions. Further, it is not appropriate to call all the expenses that result from DONATIM's shortage of working capital, the devaluation of the Turkish lira, etc., as a subsidy to producers. On the other hand, the Government could provide some compensation to producers who use, for national security reasons relating to supplies, difficult local raw materials such as lignite and local phosphate rock for fertilizer production. Only these producers need any subsidy to compete with imports on an equal basis.

V. A DIFFERENT APPROACH

The shortcomings of the current fertilizer pricing system have been patched up from time to time. Today the pricing formula is used as a tool to calculate fertilizer ex-factory prices in a generally subjective manner. The starting point for price control has always been to minimize the subsidy burden on the Government without causing losses to producers. Most producers view the present pricing formula as ambiguous. They would prefer instead a modified cost plus formula. In fact, they submitted such a formula to the Government a year ago.
If the present policy is strictly followed after establishing concrete principles for fertilizer pricing, then in the long run it might foster efficient and competitive production, given that its basis is international prices. Consider, for example, a fictitious case in which all producers in Turkey operate as offshore companies, and everything needs to be imported. DONATIM intends to buy 10 million tons of various fertilizers through tenders. Turkish producers participate in the bidding for the tenders along with international traders. If the tender is won by the Turkish producer, DONATIM will open a letter of credit for him in dollars. After receipt of the letter of credit, the producer will make delivery to DONATIM (f.o.t.) within a certain specified time. In such a situation, the producer knows his financial position before starting production, and since he will be credited dollars, he will not be hurt by devaluation and will incur practically no interest charges for financing the working capital.

In general, local producers will outbid the international traders on an f.o.t. basis. There are several reasons. For one, 35-50 percent of the cost of locally produced fertilizers are expenses in Turkish lira. Further, Turkey is very competitive compared to developed countries in costs other than materials. A majority of the plants are on the coast and have private jetty and bagging facilities.

Turkish producers could deliver their products in competition with foreign suppliers provided the price comparisons are made on an equal basis, i.e., on an f.o.t. basis. Therefore it is necessary to modify the existing ex-factory pricing formula by taking the following measures to obtain better results and encourage local producers to improve or expand their operations:

- First, realistic import prices (i.e., corrected to f.o.t. ex-factory prices) should be determined quarterly before the start of each quarter either by international tenders or by mutual agreement between DONATIM and local producers.

- Second, the percentage difference between the shadow exchange rate and the average official rate should be fixed in a manner similar to the way export reimbursements are given to general exporters in Turkey.

---

1/ Opening a dollar letter of credit for a Turkish producer will not create an extra demand for foreign exchange. The producer will use part of the dollars to meet import requirements and will convert the rest to Turkish lira to meet local obligations. All these transactions can be operated on a "bank account" basis without actually paying any foreign exchange to a Turkish producer.

2/ To stay competitive with the international market, local producers should be allowed to export part of their production, and Turkey should import the deficits, even when production capacity and demand are balanced.
Third, payments to producers should be made on time, or the burden of financing resulting from late payments must be recognized and reimbursed to the producers as a financing cost and not as a subsidy.

With these measures and their consistent application, Turkish fertilizer producers except those affected by the use of difficult local raw materials for national security considerations should not need any subsidy above a competitive f.o.t. price based on the actual c.i.f. import prices.
APPENDIX

SEMINAR ON FERTILIZER PRICING POLICIES

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