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THE ROLE OF THE WORLD BANK IN HELPING TO MEET THE FERTILIZER REQUIREMENTS OF DEVELOPING COUNTRIES

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SUMMARY

The World Bank in collaboration with other international agencies is providing both financial and technical assistance to developing countries to help them meet their fertilizer requirements. The Bank has made considerable investments in fertilizer production projects in the last few years; for example, $434 million for eight projects in 1975 alone, and it is estimated that about 15% of the additional fertilizer capacity expected to come on stream in developing countries between 1974-1980 will stem from Bank-financed projects.

The Bank, through its participation in the UNIDO/FAO/World Bank Fertilizer Working Group is helping to provide an authoritative fertilizer information system which will provide a basis for future investment and help prevent cyclical imbalances. Recent work of this Group shows there should be an adequate supply of fertilizer through 1981.

The changing needs of developing countries require a more comprehensive approach towards the production, distribution and use of fertilizers, and the paper outlines future Bank policy to meet this requirement. As an example of this approach, special reference is made to work being done on fertilizer marketing and distribution systems and also on fertilizer regional planning and developments.

THE ROLE OF THE WORLD BANK IN HELPING TO MEET THE FERTILIZER REQUIREMENTS OF DEVELOPING COUNTRIES

1. INTRODUCTION

The main objective of the World Bank Group is to provide financial and incidentally technical help for the development of poor countries. The Group consists of three financial institutions, each one meeting a particular need of developing countries; these are:

(1) The World Bank (also known as the International Bank for Reconstruction and Development);

(2) The International Development Association (IDA);

(3) The International Finance Corporation (IFC).

The Bank began operations in June 1946 and there are now 127 member nations. IDA has 116 members and the IFC has 104 members. Any country which is a member of the International Monetary Fund is free to join the Bank and the subscription is based on its economic wealth; 10% of the subscription is paid and the other 90% is not paid in but may be called by the Bank to meet its obligations arising out of borrowing or guaranteeing loans. So far, it has not been necessary to do this.

There are some basic rules governing the Bank's operations. It must lend only for productive purposes, and each loan must be guaranteed by the Government concerned. The Bank must assure itself that the necessary funds are unavailable from other sources on reasonable terms, and the Bank's decisions to lend are based only on economic considerations. Bank loans normally cover, partly or fully, the element of foreign exchange required.

A unique feature of the Bank as an intergovernmental organization is the fact that it relies mainly on private investors for its financial resources. Most of the money it lends comes from its own borrowings in various capital markets. Since the Bank obtains most of its funds on commercial terms, it must charge its own borrowers at commensurate rates of interest. On average, Bank loans are repaid over about 20 years. The Bank earns a profit on its operations, but has not paid any dividends since all shareholders agree that earnings should be used to help developing countries; part of the profit goes to reserves to strengthen ability to borrow, and the rest goes to IDA.

IDA is a financial institution, formed to help the poorest countries and gets virtually all its funds in the form of contributions. This makes it possible for the Bank Group to help countries too poor to borrow from the Bank under normal conditions. All IDA credits are for 50 years without interest, except for a very small administrative charge. Repayment of principal does not begin until after 10 years of grace. There are several criteria which a country must meet to borrow from IDA such as very unfavorable balance of payments, and a poverty ceiling which is now assessed at about $375 per annum per capita.

A so-called Third Window of the World Bank has just been created to provide development assistance on terms intermediate between those of the Bank and IDA. The chief beneficiaries of Third Window operations will also be those countries with per capita GNP's of less than $375.

The International Finance Corporation encourages and supports the growth of private enterprise in developing countries. It does this chiefly by acting as a catalyst, bringing together the necessary reserves of finance, management and technology to expand existing enterprises and establish new ones. It has the power to lend for such purposes without government guarantees, and is the only one of the three components of the Bank Group which can invest in equity.

In fiscal 1975, the World Bank Group's lending and investment commitments totalled $6,108 million. Lending by the Bank accounted for $4,320 million; by IDA $1,576 million and by IFC $212 million.

2. INVESTMENT IN FERTILIZER PLANTS

In view of the food problems facing developing countries and the importance of fertilizers in solving this problem, there has been a significant contribution by the Bank Group over the last few years in fertilizer investment and technical help on fertilizer production and use. Of all the bilateral and international lending institutions, the Bank Group has been by far the most active in investing in new fertilizer capacity in developing countries and, though more marginally, giving help in improving the utilization of existing capacity. To support these investments a great deal of investigation is required on markets and financial and technical appraisals, and this work is carried out by the Industrial Projects Department, which is also responsible for supervision during the implementation of the project.

Up to the end of 1973, the Bank Group had made total investments of nearly US$300 million in 19 fertilizer projects in 17 countries, of which US$147 million were approved between 1970-1973 for six projects.

During 1974 alone, the Bank Group made commitments of US$329 million for 7 projects in 6 countries and, in 1975, a further US$434 million for 8 projects were approved. A list of projects is given in Table 1.

Although the Bank has financed projects for the production of all three fertilizer nutrients (nitrogen, phosphates and potash), the greatest help has been directed towards the production of nitrogenous fertilizers and, in particular, ammonia and urea.

The main reason for investing in these nitrogen fertilizer projects is, that in order to make ammonia and urea at the lowest possible costs, it is necessary to produce them in large plants. These plants, together with their off-site facilities, are very expensive and in most cases, for the developing countries, can be constructed only through Government and outside help. The Bank has thus been able to fulfill an important role in providing both major financial and technical help to ensure that these projects will be realized.

It is estimated that more than three million tons of new Nitrogen and Phosphate capacity out of about 20 million tons capacity coming on stream between 1974 and 1980 in the developing countries will be from Bank Group financed projects, i.e. about 15% of the total.

TABLE 1

List of Fertilizer Projects Financed by the Bank Group from 1970 to August 1976

Country	Project	Assistance US$ Million		Date
Indonesia	Pusri Fert. (urea)	30.0		1970
India	Cochin II Fert. (NPK)	20.0		1971
India	Gorakhpur Fert. (urea)	10.0		1972
Turkey	IGSAS Fert. (urea)	24.0		1972
India	Nangal Fert. (urea)	58.0		1973
Indonesia	Pusri Fert. (urea)	5.0		1973
			147.0	
Morocco	Maroc-Phosphore (phos. acid/MAP)	50.0		1974
Pakistan	Multan (NP and CAN)	35.0		1974
India	Trombay IV (NPK)	50.0		1974
Egypt	Talkha (urea)	20.0		1974
Romania	Tecuci (urea)	60.0		1974
Tunisia	Gafsa (phos. rock)	23.3		1974
India	Sindri (urea)	91.0		1974
			329.3	
India	IFFCO (urea)	109.0		1975
Indonesia	Pusri III (urea)	115.0		1975
Bangladesh	Ashuganj (urea)	33.0		1975
Turkey	IGSAS (urea)	18.0		1975
Jordan	JFJ (phos. acid)	3.1		1975
Mexico	Guanomex (urea)	50.0		1975
Jordan	Dead Sea (potash)	1.0		1975
India	Fertilizer Industry Credit	105.0		
			434.1	
Indonesia	Pusri IV (urea)	70.0		1976
Brazil	Araucaria (urea)	50.0		1976
			120.0	

Fertilizer Unit
Industrial Projects Department
August 1976

3. THE WORLD BANK FERTILIZER UNIT

As a result of the increasing importance of fertilizers as part of the agricultural programs necessary to relieve the world food problems and the increasing involvement of the Bank Group, a Fertilizer Unit was established in 1974 within the Industrial Projects Department. The major objectives of the Unit are to coordinate the planning of Bank Group assistance in the form of both finance and advisory services for improved supply and use of fertilizers in developing countries and to devise a coherent strategy and policy to this end, taking into account worldwide trends of demand and supply. The Unit also monitors Bank Group progress towards such objectives.

As a first and important part of its activities, the Fertilizer Unit has established close cooperation with the other international agencies and industry associations involved in fertilizers. Such cooperation is essential to keep abreast of fertilizer developments throughout the world and to help ensure a unified, consistant and effective approach to the solution of fertilizer problems. Another primary task of the Unit is to monitor and prepare fertilizer statistics on supply/demand and related topics such as the price of fertilizer materials and freight costs, as a basis for investment planning.

Other important functions of the Unit are as follows:

(a) Advise on the selection, use, distribution and marketing of fertilizers to ensure that their effective use is not inhibited by constraints in the marketing/distribution infrastructure.

(b) Formulate, in cooperation with operational units of the Bank Group, lending programs for new capacity, technical and advisory work and country sector work, paying particular attention to those countries with the most urgent food and fertilizer requirements.

4. OTHER WORLD BANK FERTILIZER ACTIVITIES

In addition to direct involvement in fertilizer projects, the Bank Group is also involved in fertilizer studies through several other Bank and Collaborative Groups.

4.1 Consultative Group for International Agricultural Research (CGIAR)

The Consultative Group is jointly sponsored by FAO, UNDP and the Bank. The Bank chairs the Group and provides its Secretariat. The Group supports 10 international agricultural research stations and is currently establishing another. One aspect of this work includes plant nutrition and work on the use of chemical, biological and organic fertilizers.

4.2 Consultative Group on Food Production and Investment (CGFPI)

This Group is based in the Bank in Washington and is sponsored by the Bank, FAO and UNDP. Membership includes bilateral donors, multilateral agencies and developing countries. The work program of CGFPI will be directed toward assessing long-run food consumption needs, capacity, inputs and investment requirements and the external resources flows necessary to bring food production and consumption into balance. Although the approach is to be worldwide, attention will be focused on

those developing countries with the highest food gap and a potential for expanding production. Specifically with regard to fertilizer, the principal issues to be considered are the need for additional investment in fertilizer production and distribution capacity in the light of the supply needed to meet grain output goals.

4.3 Agriculture and Rural Development

In addition to the financial and technical assistance for production facilities, the Bank has also given help with fertilizer materials, as part of agricultural projects, to many developing countries, and a summary of the Bank's activities in this field have already been presented to the Fertilizer Society in Proceedings No. 120.

4.4 Collaboration with Other International Agencies

As well as maintaining major collaborative programs with other agencies such as UNIDO and FAO on fertilizer issues, the Bank maintains a very close contact with other international agencies through the UNIDO/FAO/IBRD "Fertilizer Working Group". In addition to the three agencies referred to, other international groups and representatives of industry participate in the meetings such as The International Superphosphate and Compound Manufacturers Association, The International Potash Institute, Centre d'Etude de l'Azote, The Sulphur Institute, The International Fertilizer Development Center and others.

Within the last year or so, this Working Group has achieved an important role as an international forum for the harmonization of fertilizer supply and demand figures. The Group provides an informal atmosphere where the various authorities can meet twice a year and discuss their fertilizer information. Where there are differences,

these can be analysed and if necessary, a judgement applied to harmonize results. This procedure meets the request of the World Food Conference, November 1974, that the international agencies as a matter of urgency establish an authoritative analysis of the long-term fertilizer supply and demand position in order to provide the elements of a world fertilizer policy that would include the overall aim of avoiding cyclical imbalances between supply and demand. The fertilizer figures presented at the meeting of the FAO Fertilizer Commission in Rome in June 1975 and June 1976 were prepared by the "Fertilizer Working Group".

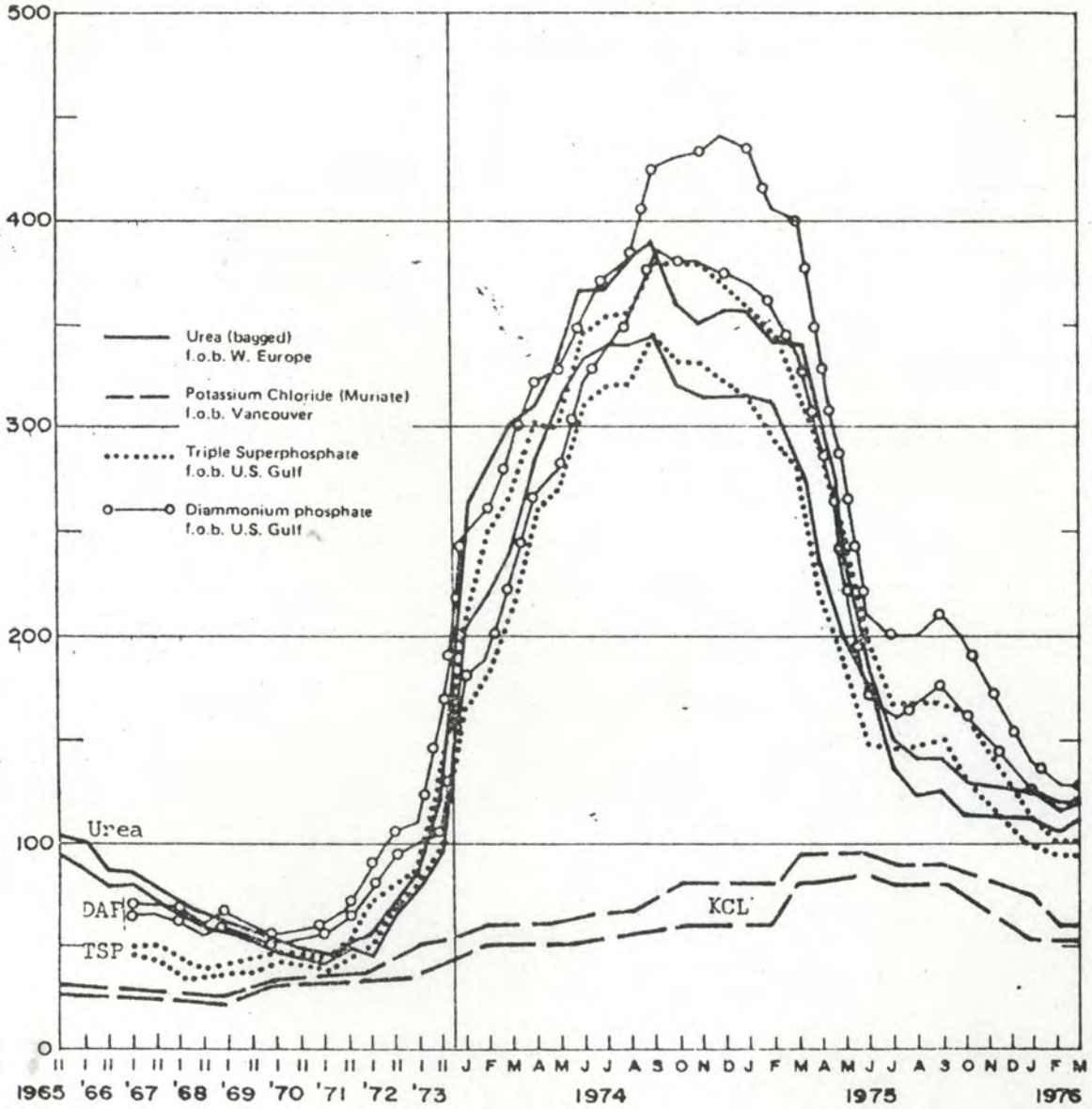
In view of the contribution of this data for investment purposes and to prevent cyclical imbalances, the Bank regards the work of this Group as extremely important.

5. WORLD FERTILIZER REQUIREMENTS

5.1 Current Situation and Future Outlook

In reviewing the current situation and longer term outlook, it is important also to consider the events of the last few years. This is well illustrated by reference to Figure 1 which shows the dramatic changes which have occurred in fertilizer export prices. There was obviously more than one reason why fertilizer prices rose so sharply after 1971. First, due to the slow down of investments in fertilizer production facilities, demand had gradually been catching up with fertilizer supply. Secondly, severe droughts and crop failures in various parts of the world led to an increased demand for fertilizers to replenish foodstocks (e.g. the U.S.A.) and this upset the already delicate supply and demand balance and

Figure 1. Export Prices for Some Major Fertilizer Materials
(U.S.$ per metric tons of product)



The double lines indicate the price ranges for each product.

resulted in a world shortage of fertilizers. Thirdly, energy and raw material prices increased significantly. The considerable publicity given to the difficult fertilizer situation particularly by the World Food Conference encouraged many large developing countries to build up their stocks of fertilizer thus aggravating the shortage, particularly at the expense of some of the poorer smaller countries.

Undoubtedly, the high prices prevailing in 1975 was the major reason for a fall off in fertilizer demand, and FAO estimates prepared at the end of April 1976 indicated that for the first time in over 30 years, world consumption of fertilizers declined. In terms of the three primary nutrients, N, P_2O_5 and K_2O, consumption in 1975 fell by 2.5% compared with the year before.

With the decline in consumption and increase in stocks in both major exporting and importing countries, prices of fertilizers have continued to weaken throughout the first half of 1976. Forecasts of world fertilizer supply and demand up to 1980/81, prepared by the UNIDO/FAO/World Bank Fertilizer Working Group in 1976, are summarized in Table 2. Taking into account expansion in production capacity and expected growth in demand, supplies of nitrogen, phosphate and potash fertilizers are expected to be adequate to meet demand during the period 1980/1981.

5.2 Implications of Projected Fertilizer Consumption for Food Production

It should be pointed out, however, that these fertilizer demand projects are "effective demand" rather than fertilizer needs, and if the world food problem is to be improved in a reasonable period of time, the rate of expansion particularly in developing countries will need to be accelerated substantially beyond that indicated in the demand forecasts.

TABLE 2

World Fertilizer Supply, Demand and Balances

	Estimate	Forecast				
	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81
Nitrogen (N)						
Production	42.41	46.13	49.69	54.14	58.65	62.10
Consumption	42.18	45.34	48.57	51.92	55.60	59.38
Surplus (Deficit)	0.23	0.79	1.12	2.22	3.25	2.72
Phosphate (P_2O_5)						
Supply	27.21	28.93	30.23	31.25	32.37	33.18
Consumption	23.83	25.56	27.20	28.89	30.35	31.75
Surplus (Deficit)	3.38	3.37	3.03	2.36	2.02	1.43
Potash (K_2O)						
Supply	28.06	28.74	29.27	29.61	30.74	31.37
Consumption	20.99	22.72	23.99	25.55	27.07	28.56
Surplus (Deficit)	7.07	6.02	5.28	4.06	3.67	2.81

Source: UNIDO/FAO/World Bank Working Group on Fertilizers, March 1976

The World Bank has recently undertaken an exercise to review the food production targets and to determine in a preliminary way the food staple availabilities in 13 major food deficit countries up to 1980. The combined official government food staple production targets in 1980 of these countries is about 280 million tons, which would make the most important of these countries self sufficient. If these targets were met, per capita food staple consumption would increase from 166 kg in 1975 to 187 kg in 1980. However, the planned level of fertilizer nutrient application to meet these production goals is 19.5 million tons of NPK, whereas our estimated effective demand for these countries is only 15.2 million tons of nutrient which is just under 80% of the target requirements.

Since fertilizer is only one of several complementary agricultural inputs, and since climatic variations tend to obscure the impact of fertilizer usage on crop output, it is not possible to establish an exact relationship between fertilizer consumption and food and agricultural production. Any estimate thereof is necessarily only a crude indication of the orders of magnitude involved. Based on the input/output relationships used in the Bank food staple exercise, one can roughly estimated the food staple deficit implied in our fertilizer consumption forecasts to be about 35 million tons in 1980, or about 12% of that year's food staple consumption target of 280 million tons.

The above estimates, however crude, clearly show that a major effort is required to promote increased fertilizer consumption. Clearly the necessary increase in fertilizer use will not be achieved

only through investments in fertilizer production facilities - in fact, the projected effective demand is based on the assumption that fertilizers are available - but through a major emphasis on fertilizer marketing and distribution including the active promotion of increased fertilizer usage among the farmers.

6. WORLD BANK FERTILIZER POLICY

The World Bank has recently reviewed its policy with regard to fertilizer development and some of the major conclusions and recommendations regarding this are summarized below:

(a) The Bank Group should continue to cooperate with other international and national agencies as well as industrial organizations and trade associations, to establish, maintain and disseminate worldwide information on fertilizer supply and demand. Such an information scheme is believed to be the most valuable and practical international measure that can be taken to provide the basis for investment planning and thereby help to avoid future cyclical imbalances in fertilizers.

(b) The Bank Group should, in close collaboration with UNIDO, provide assistance to developing countries to maximize production from existing plants.

(c) There should be greater emphasis on providing help on secondary production facilities and on the distribution and marketing of fertilizers.

(d) Bank Group plans for the next five years should continue to support investment requirements for new fertilizer production and distribution facilities in developing countries that will be required after 1980.

(e) The Bank Group, together with UNIDO and FAO, should provide technical and financial assistance to promote regional fertilizer production and trading arrangements in such areas as Latin America, West Africa, the Middle East and South East Asia.

7. FUTURE INVESTMENT REQUIREMENTS FOR FERTILIZER PRODUCTION IN DEVELOPING COUNTRIES

Increased use of fertilizer has been one of the most important factors in increasing world food production in the past 25 years, and it is expected to be even more important in the future particularly for developing countries. Although the projections for the next few years indicate that supply of all three nutrients is likely to be ample to meet demand, special attention must be given to the situation after 1981. It is not possible to predict accurately the supply/demand situation after this period but previous experience would indicate that the slow down of investment during periods of excess capacity is the main cause of the cyclical imbalances which occur within the fertilizer industry.

Also, as the total time required to plan, design, erect and commission new plants can often take as long as five years, it is important that short-term market conditions do not exert unreasonable influence on plans to meet longer term requirements. For example,

in the case of increasing nitrogen requirements, it is estimated that based on present trends, the demand for nitrogen fertilizer between 1981-1986 will increase, on average, about 5.0 million tons of nutrient per annum. Taking into account considerations such as operational efficiencies, losses, etc., it is estimated that about 20 new ammonia/urea plants will be required to come on stream per annum between 1981-1986 to meet increased demand. Also, as some older plants close down, the number required will be further increased.

Although considerable attention is being given to new methods of biological fixation of nitrogen, it seems unlikely on present knowledge that there will be any significant developments that will prevent the need for many more new large conventional ammonia plants. It is estimated that by the year 2000, we shall require at least another 500/one thousand ton per day plants even to maintain present nutritional standards. If developing countries are to meet their demand from their own production, it is certain that many of these new plants will be built in developing countries.

The fertilizer shortages and high prices that have been experienced by the developing countries during the last two or three years have raised several important issues regarding the best methods of these countries procuring their fertilizers. Under more stable market conditions, undoubtedly there would be an advantage for some of them to import fertilizers from a low cost production area. However, during periods of instability, the very high prices that have to be paid for importing fertilizer may soon outweigh this advantage. As an illustration, during 1973/74, India was paying up to US$350 per ton

for urea compared with a production cost in India of about US$150. The rapid escalation of capital costs have also, to some extent, reduced the relative advantage of low cost hydrocarbon sources. Although the economic advantages of siting fertilizer plants at cheap raw material sources still remain valid, more attention will henceforth have to be directed to helping fertilizer consuming countries move towards self-sufficiency where this is economically justified and where the premium for ensuring such self-sufficiency and a continuous dependable supply of fertilizers at more stable prices is worth paying.

The cost of building an ammonia/urea complex to produce about 1,600 tons per day urea is between US$250-300 million. For many developing countries both the investment and technical requirements will be a major constraint and undoubtedly the World Bank Group will continue to play a major role in helping these countries to meet their fertilizer requirements.

8. FERTILIZER DISTRIBUTION AND MARKETING INFRASTRUCTURE

Failure of many developing countries to raise effective demand for fertilizers is often due to constraints that occur after the production operation, and there is a need in many developing countries to reduce or remove these constraints if food targets are to be realized.

Recent developments in the fertilizer industries of developing countries have concentrated on the primary production facilities and the major investment has occurred in this area. However, as the production and availability of fertilizers increase, it is essential

that the facilities necessary for their purchase, distribution and use increase also, if the potential of greater fertilizer availability is to be fully utilized. This is particularly important in periods when prices are high and in the necessary promotional activities to encourage farmers to use more fertilizers, every effort must be made to simplify and reduce the costs of transporting and distributing fertilizers to the small farmers.

There are two major areas in which constraints to more efficient use normally occur: (a) in the distribution and marketing infrastructure; and (b) on the farm level. Constraints in the former usually relate to inadequate transportation and storage. There are often inadequate wholesale/retail organizations or credit to allow these organizations to maintain satisfactory stocks of fertilizers. Constraints at the farm level are usually caused by the farmers being unaware of the advantages of fertilizers, or by fertilizers not being available in the desired quantities or forms, or at the proper time. HYV seeds or supplementary irrigation may often be lacking. It may be that unfavorable value/cost ratios discourage farmers from using fertilizers, or that they are unable to obtain the necessary credit for buying fertilizers. Also, the procedures and facilities for buying fertilizers at the farm level often do not exist in a satisfactory form.

The World Bank has recognized the need for increasing assistance for secondary production, distribution and marketing of fertilizers in forms which are suitable for soil and climate conditions in developing countries, and it intends to put an increasing emphasis on this work.

Unfortunately, however, it is not easy to identify and put together well defined systems and investment packages which can be easily superimposed on to existing infrastructure and institutions. This type of work also requires considerable detailed study in view of the individual nature of each situation.

As part of this more comprehensive approach towards the production and use of fertilizers, it is now customary for large fertilizer projects incorporating Bank financing to include some element of financing for marketing or infrastructure or at least for further studies in this field. Within the last year, the Bank has approved a major fertilizer distribution project of $68 million in Indonesia and also has financed several other marketing and distribution studies.

In order to examine in more detail some of the problems that will have to be resolved if fertilizer use is not to be constrained by the marketing and distribution system, the Bank has been examining model systems which could be applicable in developing countries. These models cover a range of different sizes and conditions of operation. They are based on the needs of typical farming communities in developing countries and have taken into account farm sizes, cropping patterns and level of fertilizer use.

It has been assumed that the center of a fertilizer distribution and marketing system could be a secondary or satellite fertilizer production unit capable of either bulk blending or granulating fertilizers of the required ratios and concentrations. Normally such a unit would depend on the purchase of raw materials or intermediates either from a home based primary producing unit or from overseas.

The models are intended to form a framework or reference point against which existing systems can be compared so that their strong and weak points can be identified. In particular, the models have to cater for developing countries where there are many small subsistance farmers, low application rates of fertilizer and inadequate transport facilities. They place emphasis on the need to have simple, practical equipment, easy to operate and maintain under local conditions. The costs include transport, storage, secondary processing, promotion and extension services, working capital, etc.

In seven case studies covering different throughput rates and types of operation, it was found that the average investment to distribute and market fertilizers ranged from $180 - 260 per ton of annual throughput, and the operating cost of doing this was on average about $50/ton. These figures are not very different from the costs of investment and production of the fertilizer raw materials, and confirm the commonly held view that for every dollar spent on primary fertilizer production, it is necessary at least to spend one dollar on supporting infrastructure.

However, a survey of the programs of the major international lending institutions shows that whereas considerable loans have been made for the construction of primary production facilities, a relatively small amount has gone towards infrastructural requirements.

A major reason why this is so is that in many developing countries and particularly those where free enterprise prevails, the private sector has been willing to invest in, and promote, the sale of

fertilizers. Brazil is a good example of where this has occurred, originally based on imported material and now becoming based on indigenously produced fertilizers. The investment requirements and structure of marketing and distribution systems are such that they can be operated efficiently and competitively by the small scale entrepreneur.

However, in many countries and particularly those where incentives are not sufficient or available to encourage the marketing and distribution of fertilizers by private industry, insufficient attention has been given to the needs required to develop those facilities. There is growing evidence that demand, marketing and distribution are becoming increasing constraints and, unless a major effort is made to overcome these, all of the benefits expected from the investments in primary production may not be realized.

The problems of infrastructural constraints are difficult to define and resolve, but in order to illustrate them, I would like to refer to a study now being made by the World Bank in the State of Orissa, India. A Bank mission recently visited Orissa to look for suitable projects for Bank financing which would increase food grain production, and one component of this project was the increased and more efficient use of fertilizers. Orissa, with consumption of fertilizers of only 7 kg/ha of cropped area, has one of the lowest fertilizer consumption rates in India and its yield of rice, at about 900 kg/ha, is also one of the lowest in India.

Although availability of fertilizers has been a constraint in the past, at the present time the State can produce sufficient fertilizer to meet the current effective demand. Furthermore, a large urea plant is due to come on stream in 1977 which is designed to produce 220,000 tons of N per annum. Plans for increased fertilizer production and consumption require that there should be a 40% increase in fertilizer use over each of the next four years, but it is unlikely however that these projected figures can be achieved unless fertilizer demand can be greatly increased and also the necessary infrastructure provided in the way of transport and storage.

In this particular case, the Bank has proposed improved extension services which will increase the use of fertilizers and a program to provide stores and transportation, and this is now being considered as a component of a major crash project to increase grain production in Orissa. It is planned that this type of study will be extended to other states in India as part of a major plan to increase food grain production.

9. TECHNICAL ASSISTANCE AND DEBOTTLENECKING OF EXISTING FERTILIZER PLANTS

Many fertilizer plants in developing countries have been greatly assisted by the technical help provided by the Bank in identifying and appraising the projects. The Bank has also tried to ensure the proper technical and management support in projects in developing countries, by encouraging the involvement of experienced fertilizer companies in developed countries to participate in these projects.

Although the major projects financed by the Bank Group and completed during the past two years have operated at high capacities and given satisfactory performance, many other fertilizer plants in developing countries have failed to meet their rated capacity. This has often been the result of political and infrastructural constraints as well as failures in plant design and operation. A great deal of work in delineating problems and advising operators has been carried out under the auspices of UNIDO and other international agencies but often little has come of this work because there was no follow up investment program.

The Bank Group has been working on this problem particularly in India and has recently approved a credit of 105 million dollars which will be given by IDA to help to increase India's fertilizer production. It is intended that this credit will assist ten fertilizer plants in removing production bottlenecks and will help to increase fertilizer production by 250,000 tons per year of nutrient. This should allow production in existing facilities to be raised from the present industry-wide average of about 60% of capacity to 85% by 1979.

10. REGIONAL PLANNING OF FERTILIZER INDUSTRY DEVELOPMENT

Until recent times, the principal locations for the production of fertilizers, and international trade patterns have generally been unfavorable to most of the developing nations. Developing countries have been and still remain to a large extent dependent upon imported fertilizers. Within recent years, however, as the fertilizer requirements of these areas have developed, more attention has been given to

using local raw materials and to regional fertilizer development. In particular, natural gas has been found in many developing countries and is now being used as the basis for a nitrogenous fertilizer industry. Although there have been no new large discoveries of potash or phosphates equivalent to those of Canada or Morocco respectively, nevertheless there have been many interesting finds of new deposits of these materials which could support individual country or regional needs.

There are several areas in the world in which developing countries and others could benefit significantly from a joint regional plan to develop their fertilizer industry. Normally, the main requirements to obtain such benefits are that the region should contain some or all of the basic fertilizer raw materials, there should be a large and dependable market and, within the region, the location of raw materials, primary and secondary production plants should be such that the transport and distribution facilities can be optimized to bring out least cost solutions and hence cheaper fertilizers for the farmer. Although several areas do possess many of the requirements for regional development, the political problems and the difficulties of introducing proper regional planning, project preparation and implementation of the projects has usually inhibited such developments.

The Bank and other international agencies have been asked by the World Food Conference and the FAO Commission on Fertilizers to assist in regional fertilizer planning and development.

Regional planning can involve several methods of collaboration between countries and companies such as long-range contracts, harmonization of investment programs and multinational operations, but to be successful in any one or all of these, it is important that such collaboration should be based on sound economic considerations which ensure mutual benefit. It should also, as the prime motive, ensure cheaper fertilizer to the farmer than would otherwise be available.

Although the preparation of regional plans must be the ultimate responsibility of the countries or companies concerned, international agencies and particularly the World Bank, have an important role to play in helping to conceive and prepare such plans. For example, the work now being done by the international agencies in preparing estimates of fertilizer supply and demand, particularly for individual countries and regions, can serve as a basis for investment planning. The inclusion of worthwhile projects in country lending programs can often help to bring about regional collaboration.

The World Bank is currently collaborating with several other international agencies in regional fertilizer studies in several parts of the World, and to illustrate the type of work that the Bank is doing, reference is made to a study that has been carried out on a regional plan for the South East Asian fertilizer industry. In the first place, the countries which have been included in the plan are the Association of South East Asian Nations who have already indicated that they will soon formalize an agreement that will expand trade and grant preferential trading arrangements to member countries. The study

was carried out jointly by the World Bank and the International Fertilizer Development Center (IFDC), Florence, Alabama, for the Consultative Group on Food Production and Investment (CGFPI).

10.1 South East Asian Fertilizer Industry

South East Asia is an area which looks particulary attractive for regional planning and this study focuses on the fertilizer section of this area. The main objective of the study is to make an initial assessment of a regional investment production and trade program in fertilizer for 1985. The countries that might be included in such a plan but not necessarily limited to, are the ASEAN countries: Indonesia, Malaysia, Philippines, Singapore and Thailand. In fact, in the particular case studied, Singapore is excluded but Brunei is included as a potential production site. It is emphasized that once the model has been created, it is a relatively simple matter to include or exclude different countries as part of the range of parameters studied. However, the countries dealt with in this particular model are generally referred to as the ASEAN countries.

At the present time, the ASEAN countries depend mainly on imported fertilizers and raw materials from developed countries in Western Europe or Japan. However, recent developments suggest that the region possesses the raw materials and other natural facilities which, if developed in a systematic and planned manner would allow the region to become self-sufficient and also reduce the costs of fertilizers through interregional trade and improved transport and distribution facilities.

Demand for fertilizer is expected to grow significantly in ASEAN in the next decade, and capacity already installed together with capacity expansion underway will almost certainly be inadequate to meet regional fertilizer requirements by 1985. However, certain key materials for fertilizer production (natural gas, sulphuric acid) are available in the area, while others such as phosphate rock, may be available from nearby sources such as Northern Australia or the Christmas Islands. Recently discovered deposits of potash in Thailand, furthermore, may be exploitable commercially.

10.2 Objectives of the Study

Assuming that the basic objective of the ASEAN countries is to increase fertilizer production in the region in order to have greater access to fertilizer supplies as well as producing fertilizers at competitive and economic costs, one can design alternative strategies with respect to the expansion of fertilizer production capacity. One alternative, is to assume that each country adopts a policy of maximum self-sufficiency, importing the raw materials if unavailable locally, and producing both intermediates and fertilizer products for the domestic market only. Another possible strategy is that the countries of the region operate a regional capacity expansion policy that minimizes the total (= production + importation + transportation) costs of meeting total regional requirements. Such a strategy does not take into account the quite natural desire of the countries in the region to be at least to some degree self-supporting.

Comparing these two alternatives, some measure of the potential gains to be derived from regional cooperation can be obtained. Next, a strategy can be designed which incorporates elements from both policies previously described. Under this alternative, the four countries agree to collaborate in a regional fertilizer program, but insist on partial self-sufficiency in the most important fertilizer nutrient, i.e. nitrogen. In this particular exercise, it has been assumed that each ASEAN country may desire to supply 75% of its nitrogenous fertilizer requirements from domestic supply sources. The latter strategy has been selected as the one which is most likely to be the most acceptable to the ASEAN countries, and the total costs of this policy have been compared to the costs of the other two strategies. In addition, a number of detailed experiments have been conducted that serve to illustrate the sensitivity of the results to changes in basic assumptions, or to take account of specific country circumstances.

10.3 The Analytical Method and Model Considerations

To draw up an investment program for a complex industry such as the fertilizer industry requires the investigation of a large number of alternatives in terms of production and distribution. This is particularly so for an investment program for a region consisting of several countries.

The basic objectives of the study requires the determination of the investment, production, importation and transportation patterns that minimize the cost of meeting the region's fertilizer requirements. This includes the selection of plant sites, plant sizes, feedstocks, product mix and most appropriate transportation patterns.

To achieve the simultaneous specification of the optimum levels for these independent variables, a cost minimization mathematical programming model has been developed by the Development Research Center of the World Bank, Washington. The complete investment planning model permits the explicit specification of economies of scale in the production of fertilizers and intermediate products. It may incorporate a variety of intermediates and final products, regionally specified fertilizer requirements, alternative production processes in the sector as well as alternative means of transport. Finally, it permits the analysis of optimal import and export policies for the sector.

The most exhaustive use that can be made of the model is to determine the least cost investment, production and trade strategy for the fertilizer sector over a given planning period, and given specified market requirements for fertilizer nutrients. However, other uses of the model are possible as well. One of these, which is important in the context of project analysis, is to use the model framework to determine the cost implications of a given investment program or project as compared with alternative project configurations. Although the model has dynamic capabilities, the study described below is calculated on a static base for a situation in 1985.

10.4 The Empirical Background

The objective of the work is to minimize the costs to meet market requirements of fertilizers in the ASEAN region by 1985 and, as a basis, it was necessary to establish reliable demand projections for each country and also to establish comprehensive demand patterns

within each country. For each area a high and low projection was prepared so that in future sensitivity work on the model a range of investment requirements can be established on either criterion. In both cases, however, "effective" demand is used as distinct from fertilizer requirements. Effective demand is based on what the farmer is expected to buy whereas fertilizer requirement is based on optimum use without constraints in supply or infrastructure. All conventional fertilizer intermediates and products available or likely to be available have been considered.

In the study, fifteen possible sites for plant complexes have also been considered, some of which are already partly utilized. The model permits utilization of any of these sites for the creation of fertilizer complexes and includes the limitations that will exist in the amount of gas available and size of ships that can be employed, etc. The sites are shown in Figure 2.

Raw Materials

The major raw material for ammonia production is natural gas, which is available at a number of locations in the area. Some of the sites are planned to be exploited as sources of LNG for export. At such sites, an opportunity cost has been assumed. At a few locations, natural gas is not available and for there, fuel oil or naphtha have been considered as alternative feedstocks.

Substantial deposits of high quality carnallite are available in Thailand which could provide the area with potash. In the first study, this potash is assumed to be available to the region at prices

which are competitive with imports from outside the region, but in subsequent studies, the competitive position of this potash will be assessed. By-product sulphuric acid from smelting operations is assumed to be available at two locations: at Toledo City and Poro Point. In addition, sulphuric acid may be manufactured in the region using imported sulphur. Other raw materials such as phosphate rock have to be imported into the region from abroad. However, new phosphate rock deposits which are now being developed in Australia could be incorporated into the regional plan.

Investment Costs

Total investment costs consist of site preparation, battery limit investment costs, offsite facilities and working capital. Within the study, a judgement factor has been applied for offsite costs based on the actual site considered and previous experience of similar projects.

Variable Inputs

Standard coefficients have been assumed for the transformation of raw materials into final fertilizer material. Standard costs have been taken for other production costs. Here again, sensitivity analysis can be used to determine the effects of these variables, but generally they are small compared with the cost of feedstock and investment.

Transportation Costs

It was assumed that apart from bulk shipments of solids, ammonia and phosphoric acid could also be shipped. In this case, an allowance was made to account for the special storage required at both loading and unloading points.

Import Prices

One of the main objectives of the exercise is to design a regional plan which will allow fertilizers to be produced within the area and made available to farmers at lower costs than they can be imported from outside. Also, because of the cyclical fluctuations in fertilizer prices, it is necessary to operate the model using a range of imported prices for both raw materials and intermediates in order to carry out sensitivity analysis and determine the competitive situation of indigenous production against imports. In the first runs carried out, import prices were chosen at the higher end of the scale in order to simulate a situation where the demand in the area would be satisfied by local production. In further runs, the import prices were reduced so as to simulate intense competition from imported materials which allows a more critical assessment of the competitive situation.

Alternative Situations Specified for Analysis

In order to measure the effects of (1) varying degrees of regional cooperation and (2) various raw material constraints on efficient use of the region's fertilizer production resources, six different situations or scenarios were specified. The situations were defined for the degree of regional cooperation which was specified by varying amounts of indigenous N or P production, and limited versus unlimited by-product sulphuric acid.

10.6 Discussion of Results

Based on the inputs described, an optimal cost solution for satisfying fertilizer demand in 1985, together with information on investment and operating costs, fertilizer distribution patterns, plant locations and many other factors have been obtained.

As these results are detailed and require careful analysis, it is not appropriate to discuss them within this paper although the full results and analyses has been made available to representatives of the nations concerned. However, a summary of the findings is given in Table 3 which represents the minimum cost solutions for the different scenarios considered for one set of assumptions.

The two main costs in this table are total investment costs and total operating costs, and a comparison of the two extreme cases considered indicate that a complete regional plan could reduce the cost of producing and transporting fertilizers to the marketing area by about 18%, compared with the case of no collaboration. Also, investment costs would be reduced by about 10%. The results demonstrate the advantages that could accrue from a complete regional plan by 1985 under a variety of assumptions and policy constraints. In fact, the advantages of regional planning in the years between now and 1985 could be even greater than that indicated. It is a relatively simple matter to expand the model

into a dynamic one so that the optimal timing of investment between 1978-1985 can be determined.

Also, the model can be used to explore the implications of the programs as far as foreign exchange requirements are concerned. The countries involved may conceivably prefer a program which minimizes foreign exchange requirements at a somewhat higher cost, than one which minimizes total cost at higher foreign exchange requirements.

There is, of course, a fair degree of uncertainty in the assumed demand estimates and input prices. In the computer runs described in this report only the "high estimates" of demand were used. Future runs will explore the optimal program of other assumptions relating to the build up of demand and input prices with a view to finding an investment program which can be shown to be reasonably stable in the face of changes in these assumptions.

There are two main advantages of this type of approach to regional planning and collaboration:

(1) It quantitatively assesses the advantages of such collaboration and allows for harmonization of investment plans to benefit all.

(2) It provides an important guide to international institutions such as the World Bank, for the planning of financial and technical assistance to the developing nations.

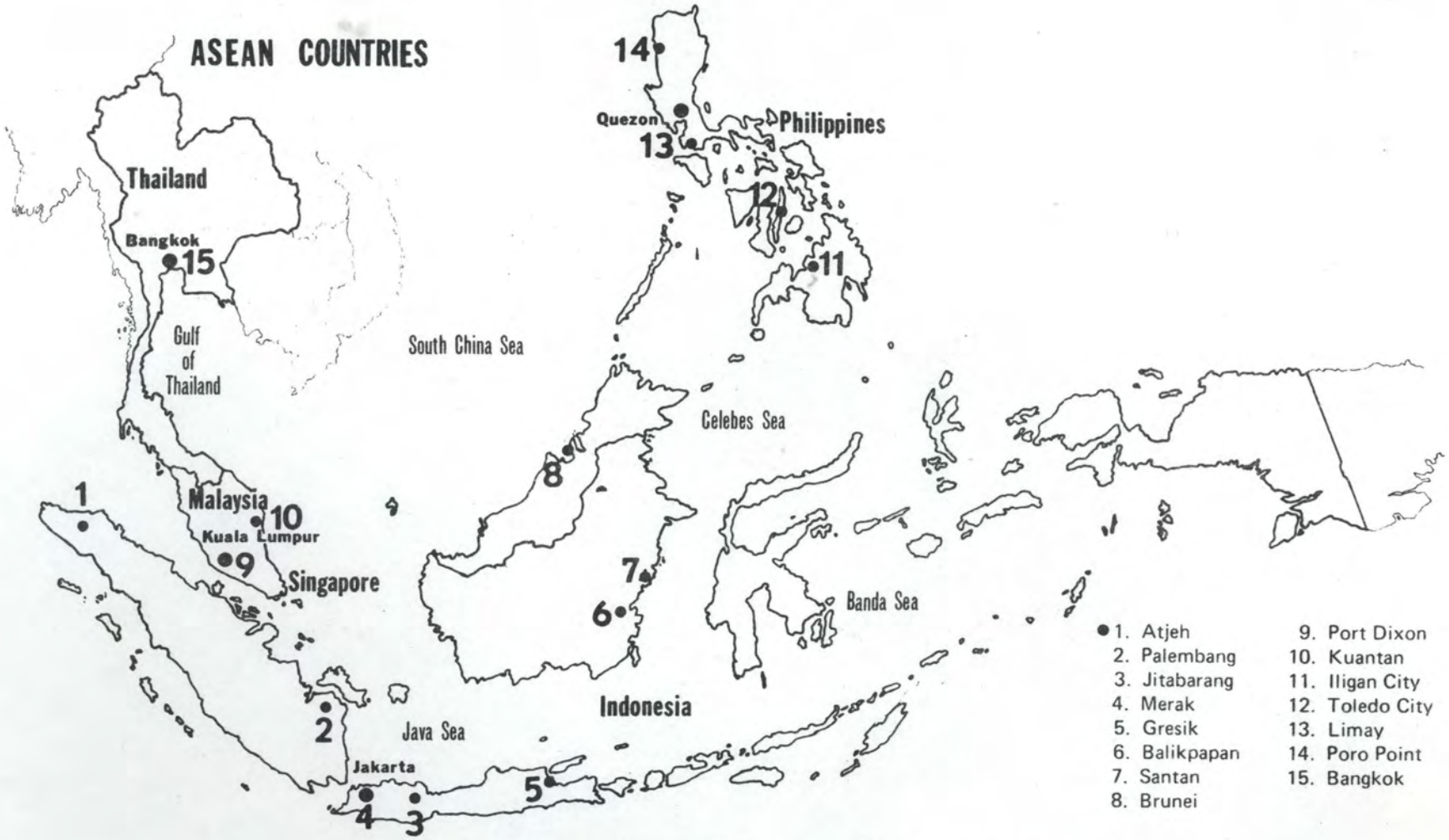


Figure 2. Possible sites for fertilizer production in ASEAN countries

Table 3. ASEAN Fertilizer Study: A Summary of the Minimum Cost Solutions, By Scenario, In Million Dollars, 1975.

Scenario Identification	A	B	C	D	E	F
Self sufficiency (minimum domestic supply of raw materials)	none	75% N	75% N	none	75% N	100% N 100% P_2O_5
Sulphuric acid ex-smelting	unlimited	unlimited	limited	limited	limited	limited
Production at Jatibarang	No	No	No	No	Yes	No
Annual Investment Charges 1/	191	203	213	200	211	216
Imports a) final products 2/	49	49	49	49	49	49
b) raw materials	119	177	202	144	202	236
Domestic raw materials and by-products	79	75	64	68	75	54
Operating costs	199	209	213	202	214	217
Sea transport	34	25	22	30	19	18
TOTAL Annual Cost	671	738	763	693	772	790
TOTAL Investment	1370	1441	1517	1441	1503	1553

1/ Including working capital.

2/ This item refers to potash requirements, and represents the sales in the region of product from the proposed potash development in Thailand.

11. CONCLUSIONS

The World Bank Group is playing an important part in helping the developing countries to meet their fertilizer requirements. In order to do this, it is collaborating with the other international agencies as well as industry to ensure that the best information is available to provide a basis for investment planning and to avoid cyclical imbalances in fertilizers.

The Bank Group will adopt an increasingly comprehensive approach to fertilizer developments to see that as well as assistance to ensure the efficient production of fertilizers, help must also be given so that demand and infrastructural considerations do not become major constraints to fertilizer use.