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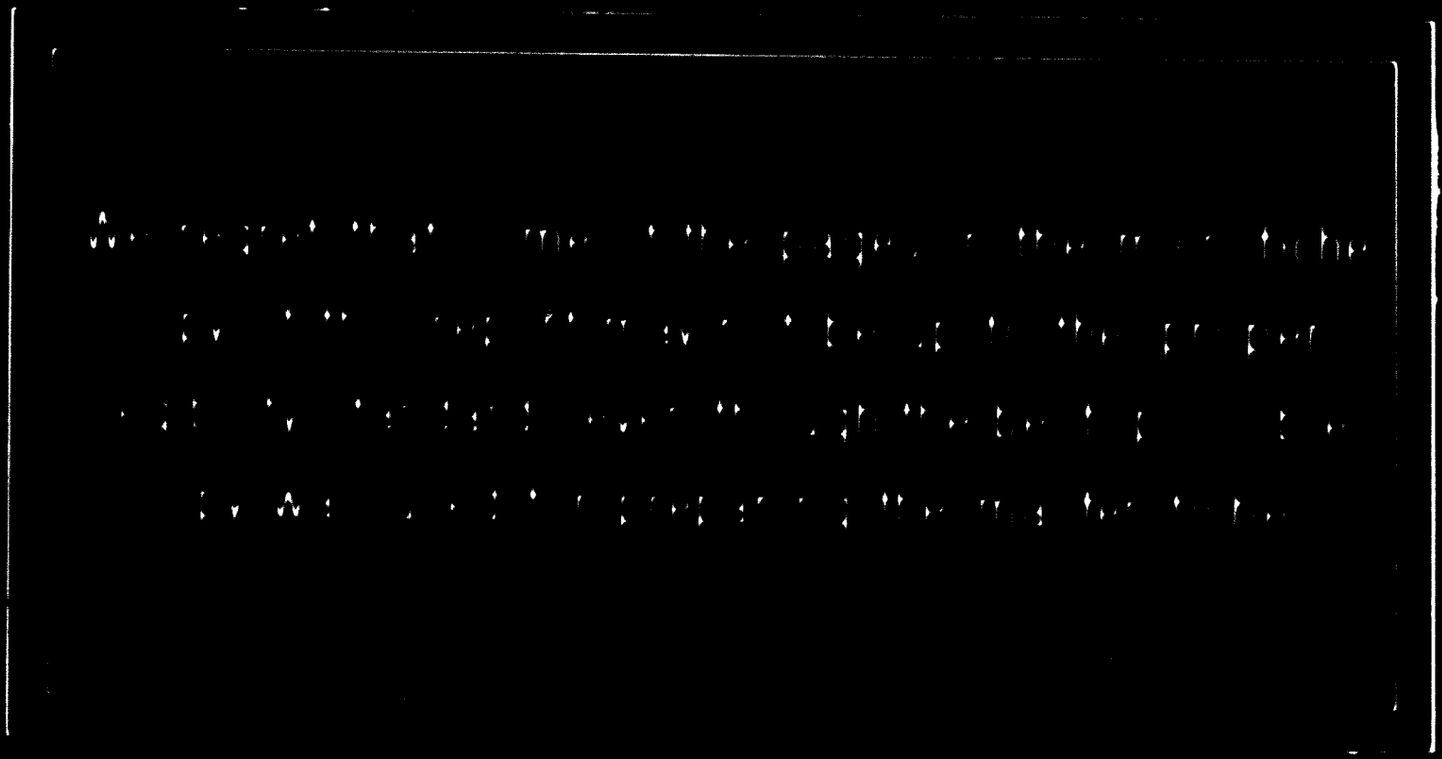

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UNIDO/ESCAP DP/CPPD/8
3 February 1978

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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION (UNIDO)
ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC (ESCAP)

REGIONAL CO-OPERATION IN CHEMICAL FERTILIZER

A report from the joint UNIDO/ESCAP Priority Project on Regional Co-operation in Chemical Fertilizer Production and Distribution, financed by UNDP as RAS/74/045 and conducted in the ESCAP region during 1975

Note: This paper has not been cleared by the Office of the Executive Secretary of ESCAP, formally edited or translated.

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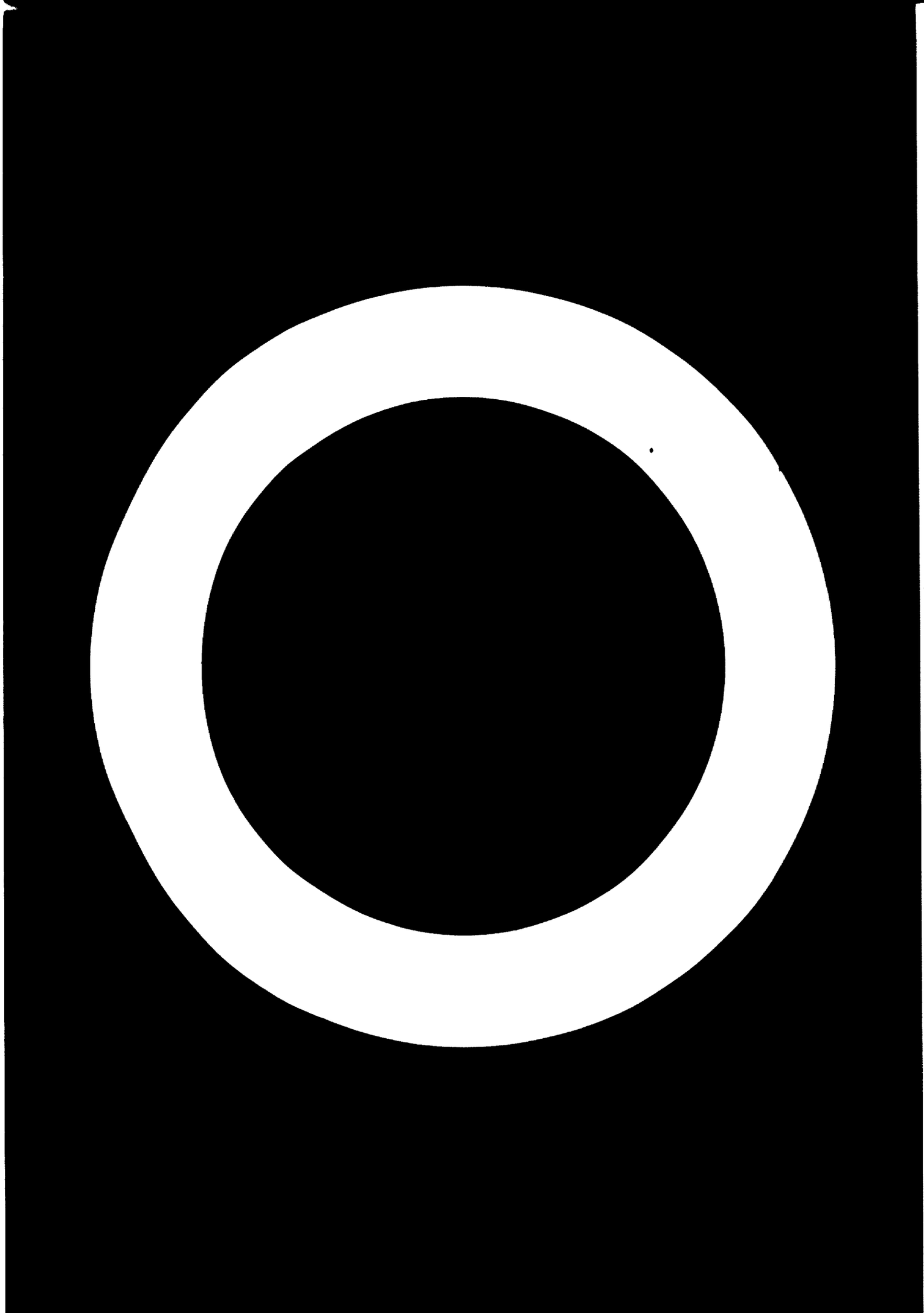

FOREWORD

1. This paper, authored jointly by the United Nations Industrial Development Organization and the Economic and Social Commission for Asia and the Pacific represents the final phase of the Priority Project on Regional Co-operation in Chemical Fertilizer Production and Distribution on which the two agencies collaborated in 1975. The project, which included country missions, the preparation of several papers and the convening of an Expert Group, was undertaken in response to requests by its Member Governments that ESCAP explore the possibilities for regional co-operation to deal with some of the serious problems involved in the supply of fertilizer and other agricultural requisites in order to raise food output on Asian farms. The project commenced during the waning of the "fertilizer crisis", brought about by short supplies and high prices of fertilizer. At this time, governments of developing ESCAP countries were implementing extensive plans to expand domestic production, in order to reduce their dependence on imported supplies and to exploit their own raw materials for fertilizer production. These plans include bringing about 7 million tons/year of new nutrient production capacity on stream in nine countries by 1980, in addition to large expansions expected in China and other socialist countries.

2. For this reason the paper deals with two separate periods: the fertilizer situation towards the end of the present decade and additional investment required to attain regional self-sufficiency during the eighties. An Introductory Part A traces the main features of the problems which have occurred in the first half of the seventies and outlines the various efforts which have been made internationally to help ensure adequate food and fertilizer supplies. It also describes the difficulty and importance of forecasting demand accurately before investment plans are finalized, and indicates the approximate magnitude of demand in the region over the next 15 years, using official estimates and other opinion. The avoidance of unsaleable surpluses and the identification of export markets both require more accurate demand predictions, especially in the light of the cost and supply considerations which are treated in Part B. These considerations include the results of present investment plans, the endowment and relative cost of raw materials in the ESCAP region, and the huge investment and production costs involved in producing chemical fertilizers in modern plants.

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3. On the basis of the demand, supply and cost considerations raised in the first two parts, Part C discusses the supply-demand balances which are likely to occur in each of 11 ESCAP countries, indicates the amount of additional capacity which would be necessary for each to be self-sufficient, and explores the scope for intraregional trade in order to better exploit comparative advantage to gain cheaper supplies. Necessarily these discussions are based on a fairly arbitrary selection of supply and demand possibilities, and therefore are illustrative rather than predictive. The need for more extensive and precise monitoring and forecasting of trends affecting the industry cannot be too greatly emphasized. The last chapter in Part C continues the trade discussion by arguing the scope for subregional arrangements which would both protect the investment made in production for export and ensure that imports from neighbours be as secure as less efficient domestic production would. In the final Part D various forms of regional co-operation are recommended, including both subregional economic collaboration and regional activities to complement external financial and technical assistance in projects which should raise the productivity of existing and new domestic fertilizer plants in the region.

4. The paper's Summary and Recommendations, which immediately follow this Foreword, have been distributed already to ESCAP Member Governments as document no. E/CN.11/L.422/INF for the XXXIInd Session of the Commission. The full paper is also being distributed, in order that serious consideration of the recommendations arising out of the Priority Project may be assisted by an understanding of the problems which they are designed to solve or avoid through prompt anticipation. There is scope for the development of a healthy chemical fertilizer industry in the ESCAP region and its contribution to the generation of domestic food supplies and exchange-earning agricultural produce must not be endangered by a failure to ensure maximum efficiency for it.

5. The paper includes also, as Annex III, a 'Final' Report dealing with procedural aspects of the Priority Project. As well, I would like to acknowledge at this point the major extra-budgetary assistance by the United Nations Development Programme which enabled the project to be carried out.

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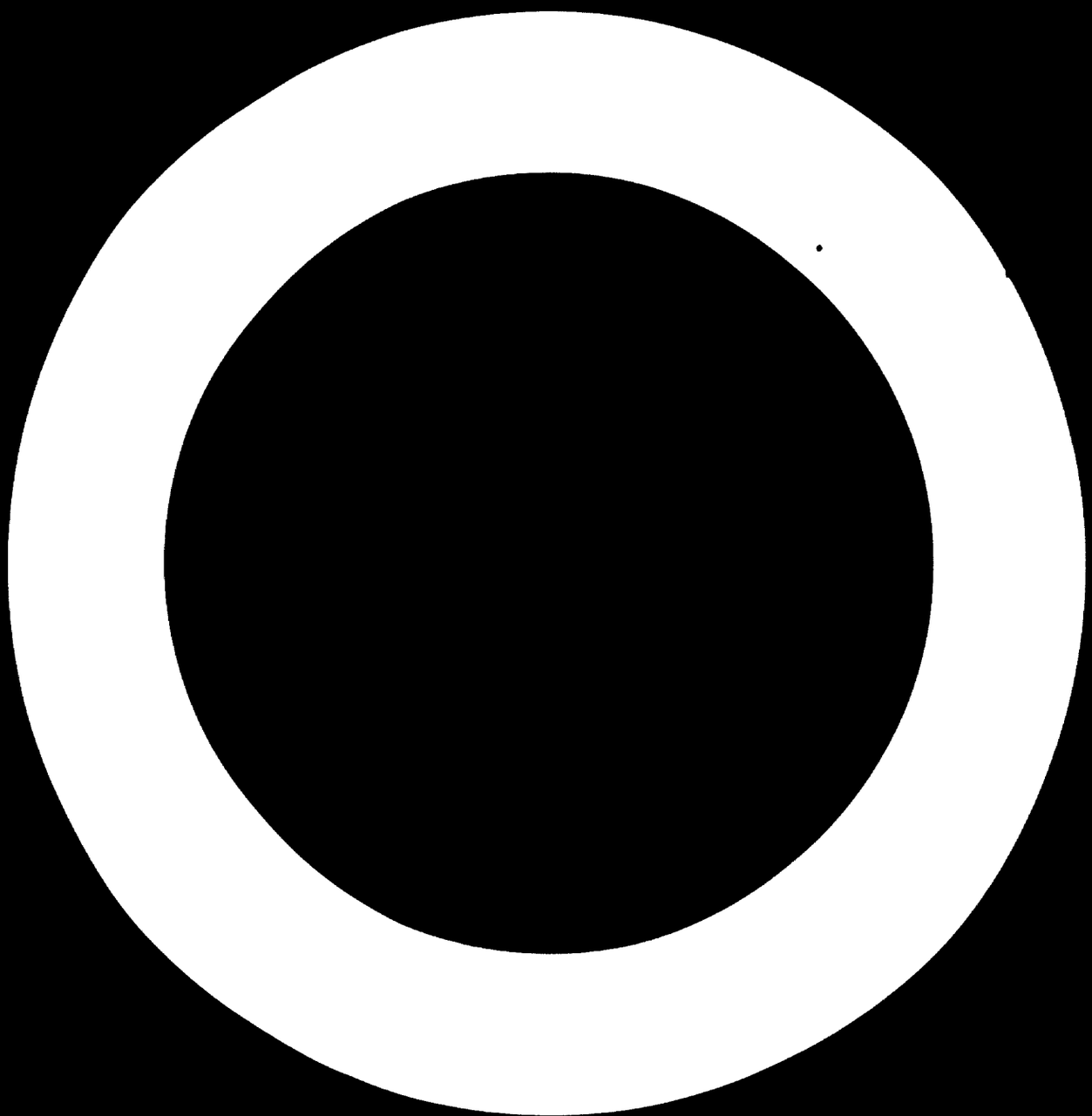
It is also desirable to express the appreciation of the ESCAP Secretariat for the important contribution made by the Chief and officers of the Fertilizers, Pesticides and Petrochemical Industries Section of UNIDO, which assumed the responsibility of executing the project in co-operation with ESCAP. Harmonious co-operation between the UNIDO group and the ESCAP Task Force on Fertilizers and Agricultural Chemicals has contributed greatly to the quality of the work done, as has the very helpful participation of officials of many Member Governments and several international agencies. Finally, I would like to thank the experts who lent their wisdom to form a very constructive Expert Group, and the several consultants who brought considerable expertise to the analysis and recommendations formulated in the course of the project.

J.B.P. Maramis
Executive Secretary
United Nations Economic and Social
Commission for Asia and the Pacific

/SUMMARY



SUMMARY AND RECOMMENDATIONS*

1. The importance of domestic food production is a major preoccupation of development planning. Whether countries with growing populations elect to concentrate on their agricultural sectors to raise GNP and exports, or whether they encourage industrialization with its corollary of millions of urban mouths to feed, the maintenance and expansion of agricultural production is crucial. In several developing countries over the past half-decade, chronic food shortage situations have occurred, attaining famine or near-famine proportions.

2. This crisis became especially acute around 1973 when years of adverse weather conditions impaired the production of cereals in developed food-exporting countries as well as developing countries. Those developed countries which did have surplus grain production found ready markets in other developed countries which had experienced poor harvests, and the consequent limitation on international food-aid made the poorer and more populous developing countries even more dependent on their own declining food production capacity.

3. Unfortunately, the rapidly increasing oil and fertilizer prices and a world shortage of fertilizers resulting from previous reductions in investment in fertilizer projects combined with sometimes already severe balance-of-payments deficits to severely affect the capacity of most developing countries of the ESCAP region to raise food production. At a time when food reserves were reduced to dangerous levels, the high prices and short supply of fertilizer slowed progress on the "green revolution" by precluding even the maintenance of fertilizer imports to raise or maintain food production in subsequent years. As well as affecting food output, the fertilizer shortage has harmed cash crop production, a major source of foreign exchange for many of the countries.

4. Fertilizer consumption in the ESCAP region is already low by world standards. The application rate of nutrients per hectare of arable land was only 32 kg in 1973/74 for the whole of Asia and, if the high rates of north-east Asia are excluded, the average would be closer to India's level of 17 kg. This may be compared with 200 kg in Europe and 74 kg in North and Central America. Per capita, of course, the situation in Asia is even more serious, with only Japan, the Democratic People's Republic of Korea, the Republic of Korea, Malaysia (West) and four Middle East countries exceeding 10 kg and some countries achieving only about 2 kg. The comparable rates in Europe and North and Central America were around 60 kg per head.

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* Also distributed as document E/CN.11/L.422/INF and its CORR.1.

5. Although the financial return on the expanded use of chemical fertilizer appears to be positive and even considerable in many Asian situations, the high prices which have occurred in the early 1970s have hardly been conducive to small farmers' acceptance of new fertilizer-intensive techniques. Asia's traditional sources of supply in Japan, Western Europe and North America raised their prices in response to the world shortage, the price of bagged urea in 1974 reaching almost seven times its early-1972 level and other products showing fourfold or fivefold increases. Transport costs have also risen to cause further distress to the importing countries.

6. Not only has the fertilizer crisis resulted in reduced application, but it has aggravated still further the position of foreign exchange deficits of developing ESCAP countries which in some cases were already severe. For 18 of these countries, the cost of fertilizer imports is estimated to have risen from less than $US 700 million in 1973 to over $ 1,200 million the following year, an extra billion dollars which these countries could ill-afford. Thus, in spite of smaller quantities in some cases, the high fertilizer prices helped take balance-of-trade deficits to dangerous levels; for example, over $900 million for India and $ 400 million for Bangladesh and Pakistan. A few countries such as Indonesia, which were earning increased oil revenues at this time, were able to sustain higher fertilizer prices, but for the majority the adverse repercussions of the crisis were serious.

7. International efforts were made to alleviate the problem, the most important measure being the establishment of an International Fertilizer Supply Scheme to encourage bilateral and organize multilateral aid in fertilizer and cash. The scheme should have been of particular significance to Asia, which accounts for three-quarters of the plant-nutrient needs of the "most seriously affected" countries on which the scheme focused attention. However only about 100,000 metric tons of various fertilizers, or the cash equivalent, were supplied to ESCAP countries in the 1974/75 fertilizer year, leaving a deficit which, the IFSS secretariat has calculated, represents almost 3 million tons of grain production. As the crisis continued, it became increasingly apparent to the developing countries themselves that the solution to their food and fertilizer needs must lie in their own hands. Appropriately, the focus of international activity has shifted towards those measures which will help the developing countries to become less dependent on external supplies.

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8. A wide range of international institutions and activities was [illegible] mobilized over the past two years. The most important global event, and a catalyst for much other activity and institution-building, was the World Food Conference in Rome in November 1974. This encouraged and expanded the ongoing work of the Food and Agricultural Organization of the United Nations, the United Nations Industrial Development Organization, the World Bank Group and other international agencies, as well as establishing new forums and programmes to relieve the temporary situation and expand food production in the longer term. New institutions and activities include the World Food Council, the Committee on Food Aid policies and Programmes, the Committee on World Food Security, the International Fund for Agricultural Development, the Declaration and Plan of Action on Industrial Development Co-operation, the Consultative Group on Food Production and Investment in Developing Countries, and the UNIDO-FAO-IBRD Working Group on Fertilizers. These complement existing programmes, which have included the extensive provision or commitment of World Bank Group funds for investment in the expensive new fertilizer production facilities in developing countries.

9. World fertilizer prices are now declining and are expected to remain moderate during the present decade as large quantities of the new capacity come "on-stream", especially in parts of the world with newly discovered or exploited reserves of feedstocks and raw materials for fertilizer manufacture. However the Asian population, food requirements and fertilizer market will be expanding at the same time and countries fear that future fluctuations in the supply and prices of essential nutrients could have even more serious consequences for food production and the balance of payments than in the early 1970s. This fear has provided an important motive for increased self-reliance.

10. In addition, there are several developing Asian countries with natural resources which can be tapped for fertilizer production within the region, thus reducing the dependence on external supplies and/or [illegible] earning precious foreign exchange. The wish to develop and exploit these local resources coupled with the chronic foreign exchange shortages, and the desire to protect themselves against possible future below-cost exporting and substantial fluctuations in world fertilizer investment, supply and prices, have led to the adoption of national policies aimed at the considerable expansion of fertilizer production within many developing countries. This drive for partial self-sufficiency is especially marked in the ESCAP region, where the

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fertilizer industry has traditionally produced only a small proportion of the requirements, and that often in small or otherwise inefficient plants producing an inappropriate or high-cost product. Now most ESCAP member countries, especially those seriously affected by the world market supply and price situation in both fertilizers and raw materials, have stepped up their plans to create new fertilizer production facilities and to overhaul old ones.

Demand

11. An accurate prediction of each country's demand levels over the next decade or so is very important if the appropriate amount of regional investment in new production facilities is to be known. It is important for several reasons. In the first place, the recent high prices, the drive for self-sufficiency in other importing countries, and the world-wide desire to exploit hydrocarbon reserves have expanded investment in the industry. The consequent increases in output are likely to keep world fertilizer prices down and deny developing ESCAP countries the opportunity to export possible surpluses of their own, especially where these are generated from relatively high-cost production facilities. In the second place, the amount of capital investment now required to create new capacity on an economic scale is very large. Thus, its misallocation in capital-scarce economies would have serious effects on other industrial and agricultural development as well as harming the foreign exchange position which self-sufficiency is designed to help.

12. However, the accurate prediction of demand is also difficult, and official and observers' estimates of future demand levels vary widely, indicating the urgent need for better and co-ordinated research on this aspect of the market. Not only economic considerations but also the likely effect of official measures to raise actual consumption towards target requirements must be taken into account. Projections of demand for the output of domestic facilities are made difficult by the many underlying and related factors which are difficult to quantify, including: per capita food consumption, domestic food production, fertilizer and crop prices, economic returns from fertilizer application, price and income elasticities of demand, changes in the distribution system, government subsidy levels, the strength of desires to avoid dependence on imports, and the growth-rate of national income itself.

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13. Pending reliable estimates, it appears that by 1979/80 consumption of nitrogen will be about 3.5 million tons in India, 0.6 in Pakistan, between 0.3 and 0.6 in Indonesia, the Republic of Korea and perhaps Iran and the Philippines, about 0.2 in Bangladesh, and less than 0.15 in Malaysia, Thailand, Sri Lanka and Afghanistan. The ASEAN subgroup total would be just over 1 million tons N, while that of all 11 significant consuming countries together may total between 6 and 7 million tons in 1979/80.

14. Rather less reliable estimates for the succeeding half-decade suggest a 1984/85 total of between 9 and 11 million tons N for the above 11 countries' consumption, including about 5.7 in India, 1.1 in Pakistan, 0.8 in Indonesia, between 0.3 and 0.6 in the Republic of Korea, Iran, the Philippines and Bangladesh, about 0.2 in Malaysia, and between 0.10 and 0.15 in Thailand, Sri Lanka and Afghanistan, with an ASEAN subtotal of about 1.6. Only rough magnitudes can be postulated for 1989/90, when the consumption total could be between 12 and 17 million tons N for the 11 countries, that is at least three and perhaps five times the total for 1973/74. ASEAN should account for 2 million of this total.

15. Meanwhile, demand for fertilizers and compounds containing the phosphatic (P_2O_5) and potassium (K_2O) nutrients are expected to expand more rapidly from their lower bases as a better balance is attained in the application of N, P and K to Asian farms. By the end of the present decade, consumption of P_2O_5 in the 11 countries is expected to have more than doubled its 1973/74 level to reach 2.7 million tons. This would include 1.2 million tons P_2O_5 for India, about 0.2 to 0.3 for each of Iran, the Republic of Korea, Pakistan, and Indonesia, and around 0.1 million tons for the Philippines, Thailand, Malaysia and perhaps Bangladesh. The ASEAN countries altogether would consume about 0.5 million tons P_2O_5 in 1979/80.

16. Strong growth is expected to continue during the following decade, bringing the 1984/85 total to about 4.2 million tons P_2O_5, with ASEAN accounting for 0.8 and India alone approaching 2.2 million tons. The maintenance of the growth rates implied by these volumes through the end of the 1980s would yield totals of 1.2 million tons P_2O_5 for ASEAN, 3.8 for India, and 6.6 for the 11 countries together in 1989/90, fully five times their 1973/74 consumption.

c. Production

Production

17. The preceding paragraphs indicate the magnitude of the demand which developing ESCAP countries now wish to meet through their domestic production of nutrients. Existing installations in the same countries of south and southeast Asia now represent a combined capacity of almost 4 million tons N and just over 1 million tons P_2O_5. However, low utilization rates have held output well below the group's consumption level: an average rate of about 60 per cent has allowed domestic production to reach only 2.7 million tons N and 0.6 million tons P_2O_5, meeting about two-thirds of the demand for N and half of that for P_2O_5 in 1973/74. Only the Republic of Korea and (temporarily) Bangladesh have attained self-sufficiency in nitrogen, while in P_2O_5 only the Philippines and to a lesser extent the Republic of Korea and Iran have even approached it.

18. Utilization has been inhibited by factors such as equipment failures, poor maintenance, inadequate power supplies, difficulty in obtaining spare parts and feedstocks, and weak management. Urgent assistance and co-operative efforts are needed to deal with these problems in the older plants, and care is necessary to ensure that some of them do not occur in new facilities. Some existing plants also suffer the disadvantage of having been built to use forms of hydrocarbons which are now relatively expensive; however, new plants are being designed to make greater use of natural gas and heavy fuel oil.

19. In addition to national efforts to facilitate the operation and management of fertilizer plants, various international agencies, either individually or jointly, have been increasingly active in assisting developing ESCAP countries by identifying the critical bottlenecks, formulating debottlenecking plans and programmes, providing the foreign exchange necessary to import needed inputs, strengthening in-plant technical and supervisory training programmes, providing loans for improving the economic infrastructures necessary for uninterrupted operation of the existing fertilizer plants, helping solve distribution and marketing problems, and organizing conferences, seminars and workshops to draw greater attention by the international community to the problems of underutilization of fertilizer production capacity.

20. Developed countries, too, have assisted developing ESCAP countries in making fuller utilization of the existing fertilizer production capacities by providing loans and technical assistance. Such bilateral assistance has come mainly from developed countries exporting fertilizer plants and equipment as

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well as technical know-how. The bulk of the fertilizer aid programmes of most developed countries and international financing agencies, however, has been concentrated in increasing fertilizer production capacities, and this without the benefit of any commercial scheme for developing ESCAP countries as a whole.

21. An extensive programme is now in hand to expand chemical fertilizer production capacities in many developing ESCAP countries. Since these entail huge investment costs, the programme requires the according of priority to financial support provided by governments, or arranged by Governments with financial organizations or Governments from outside the region. In many of the countries, the identification of problems and decisions for the rapid promotion of investment projects was made during 1973 and 1974, with the result that a large number of ammonia/urea plants, many of them based on low-cost indigenous natural gas, are already under construction in the region. The countries of India, Indonesia, Pakistan and Iran have particularly large volumes of capacity coming on-stream by 1979, with lesser amounts in hand in Bangladesh, Sri Lanka, the Republic of Korea, the Philippines and Afghanistan. China also has a comprehensive network of plants under construction, while plans are in hand or under consideration for new facilities in Burma, Malaysia, Thailand, Brunei and even Singapore.

22. In contrast to nitrogen, national development of the phosphates industry is less feasible in the short term for most ESCAP countries, and the deficit consumption/production balance will have to continue to be covered by imports. Raw material availability (rock phosphate as well as sulphur) is the major constraint on the attainment of self-sufficiency in the countries in the region. However, rock phosphate has been discovered in Australia and in a few other Asian countries. Potash raw materials are even more scarce in the region, and development of this industry is likely to occur only in the medium to long term, and then only in the two Mekong Basin countries which have carnellite and sylvite deposits.

23. Present efforts to expand output in order to approach self-sufficiency over the current half-decade are likely to cause the production capacity of the group of 11 countries to increase by about 7.4 million tons N and 1.3 million tons P_2O_5 by 1980. The group's total capacities would then be 9.2 millions tons N and over 2.3 million tons P_2O_5, from which offtakes of 7.6 and 1.7 million tons might be expected in the 1979/80 fertilizer year. In so far

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as there may be an inherent tempo on the expansion of output, extrapolation of past growth trends suggests rather more conservative estimates. However, official enthusiasm is high and failures to achieve some of the present installation and utilization targets could be offset by over-achievements in other areas. Individual country estimates of nitrogen capacity in 1979/80 include about 3.8 million tons in India, between 0.8 and 1.0 in Pakistan and Indonesia, 0.6 in Iran and the Republic of Korea, 0.3 in Bangladesh, and 0.1 in Afghanistan, the Philippines and Sri Lanka. The situation in Malaysia and Thailand - small production levels from existing facilities - is unlikely now to be changed by the end of the decade.

24. A further considerable expansion of capacity is anticipated throughout the region during the 1980s. Installations now being planned or considered should raise available capacity by at least a further 3.9 million tons N to 12.7 million tons N in mid-decade. This capacity would produce about 11 million tons N in 1984/85. Moreover, present official intentions with respect to achieving self-sufficiency and exploiting gas reserves could cause a very much greater expansion of capacity during the 1980s as a whole. Although domestic demand will be expanding concurrently, it is fortunate that there is time, before the huge investment is committed, for each country, subgroup and the ESCAP region to consider carefully the likely effective domestic and export demand for its output in the light of its relative production cost structure and its alternative sources of imports, uses for indigenous raw materials, and opportunity costs of capital.

25. Natural gas is usually the cheapest feedstock for ammonia and nitrogenous fertilizer manufacture. It is becoming the most important feedstock in the new ESCAP plants now under construction and, although an emphasis on fuel oil is expected in the 1980s, gas will remain important, including its export following liquefaction. Several consuming ESCAP countries have gas reserves, very large in the case of Indonesia. Since naphtha has become very expensive, it will be used, like coal, in new plants only in special circumstances. A few plants using these feedstocks are now under construction or consideration in countries with insufficient indigenous gas (India) or with none (Sri Lanka, the Republic of Korea). Most other fertilizer-consuming countries are more fortunate in having the option of domestic gas-based production to meet all their needs. In some cases, export of part of this production might be feasible; in others it will be essential in order to avoid sub-optimal output levels.

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26. The cost advantage of nitrogenous fertilizers derived from natural gas stems from the latter's alternative-use value and consequent cheapness, the lower investment costs and other elements of production costs associated with its use, and the relative efficiency of its energy content. Various exercises have demonstrated the usually considerable cost advantage of fertilizer products based on gas when it is cheaply available. However, the opportunity costs of investing capital and using domestic gas in fertilizer production both need careful evaluation in the light of relative feedstock and product prices, transport costs and alternative industrial or other investment possibilities and markets.

27. Phosphate rock and sources of sulphuric acid, both necessary for phosphatic fertilizer manufacture, are less evenly spread around the region. Few countries have both, but there may be some scope for trade in these inputs to expand the manufacture of phosphoric acid and the fertilizer products based upon it. This trade would include Australia, which has very large rock deposits in Queensland. One ASEAN country, the Philippines, has a major plant under serious consideration to utilize sulphuric acid derived from its proposed copper-smelting activities. Potash salts have been discovered only in Thailand and Laos, and early exploitation of these is not anticipated: a significant industry serving the region might develop during the 1980s however.

28. Assistance is desirable to help developing ESCAP countries develop their indigenous raw materials. Moreover, there may be scope for bilateral or subregional arrangements to share regional experience in such development, to exchange different raw materials, to trade inputs for other products or intermediates, or to provide capital and expertise abroad to develop economic industries close to their raw materials source.

29. An important advantage for developing countries with gas reserves is that the use of natural gas rather than other hydrocarbon feedstocks yields savings in the investment as well as the operating costs of ammonia/urea production facilities. However, developing countries entering the industry must overcome two main disadvantages: their new capacity will incur much higher capital costs than competing existing facilities elsewhere, and it is more expensive to install than it would be in developed countries. The latter factor, which may correspond to a differential of 25 per cent or more, may be compounded by the less adequate infrastructure of developing countries. Since there are substantial returns to scale in the industry and equally significant savings by maintaining high rates of utilization, regional and subregional

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markets should be served by the minimum necessary number of large plants operating at full capacity.

30. Subregional co-operation should also take advantage of the fact that transport is cheaper over short distances, except that this advantage over long-haul imports may be eroded by the latter's bulk carriage in large vessels. Conversely, high local transport costs may give subregional plants advantages over domestic ones serving domestic but distant markets. Gas and coal are less portable than other feedstocks, although once gas has been liquified (LNG) it can be carried long distances quite cheaply. In general, most feedstocks and ammonia cost less to ship than urea in terms of their nutrient potential.

31. In addition to the effect of the factors cited on the costs of producing any particular product in various locations, it is necessary to evaluate the different costs of producing the several feedstocks, intermediates, basic fertilizers and NPK compounds, which vary with circumstances. A regional or subregional output pattern covering all of these items should be developed on the basis of raw materials availability, access to markets, scale economies, infrastructure and other elements of comparative advantage.

Balances and trade

32. The nutrient supply-demand balance which will occur in each country over the next 15 years cannot be easily predicted, and national planning has had to proceed on the basis of only a rudimentary awareness of neighbouring countries' surpluses or deficits. A better understanding of the consequences of its own investment actions, and of the likely supply-demand balances of neighbouring and other potential competitors and sources, is important for each producing country. Unless demand is expanded quite rapidly, surpluses will appear in nitrogen production about 1980 in several of the 11 countries under consideration, and for the group as a whole. The implementation of present intentions might yield even larger surpluses as the next decade proceeds; alternatively, delays in the establishment of new facilities and/or failure to meet ambitious target rates of capacity-utilization could result in shortages reappearing, especially if efforts to bring actual consumption closer to application targets are as successful as food requirements warrant.

33. The demand and supply levels for 1979/80, alluded to earlier, yield an 11-country surplus of 0.8 million tons N and a deficit of more than a million tons P_2O_5. The nitrogen surplus could be up to 1.6 million tons N if demand

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were weak, or eliminated altogether by strong demand in each country. The latter situation would consist of deficits in India and perhaps even the Republic of Korea, as well as larger shortages in the three ASEAN members already in deficit. At the other "weak demand" extreme, substantial surpluses would occur in Indonesia, Iran, Pakistan, Bangladesh and even India. However an "average demand" 0.6 million-ton deficit might be composed of surpluses of 0.2 million tons or more in each of Iran, Indonesia, Pakistan and perhaps Bangladesh; moderate surpluses in Afghanistan, India, the Republic of Korea, and Sri Lanka; and a combined deficit exceeding 0.3 million tons in the Philippines, Thailand and Malaysia.

34. Full self-sufficiency in all nutrients cannot be anticipated for any of the countries, most of which will continue to import some raw materials or intermediates, if not products or even compounds and mixes. To provide a reference point, however, the amount of new capacity needed to be established during the 1980s in order to meet all of the domestic N and/or P_2O_5 demand from local facilities could be derived from average consumption estimates and the amount and utilization of capacity expected to have been installed already in 1980. For the group as a whole, new construction with nameplate capacity totalling about 3 million tons each of N and P_2O_5 would need to be completed by 1984/85; and further amounts of about 6.5 million tons N and 3.0 million tons P_2O_5 would need be installed in the second half of the decade.

35. Thus, the new capacity which would have to be installed during the 1980s to achieve self-sufficiency would total around 10 million tons N and 6 million tons P_2O_5, implying a very large capital investment. More seriously, if self-sufficiency were the motive underlying such developments, the new capacity would be located in a sub-optimal pattern around the region. This would raise production costs and fertilizer prices, endangering demand and thus food production in the region. Moreover, it would deny countries endowed with raw materials the opportunity to take advantage of those resources and, at the same time, supply their neighbours with cheaper fertilizer. If these countries did continue to invest in transforming their gas, etc. into fertilizers for export, they might find themselves faced with tariff barriers erected by neighbours wishing to protect their own new capacity.

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36. One key to the problem of future surpluses and deficits in the ESCAP region is intraregional trade, however, provided it is based on rational investment patterns. As far as the next four fertilizer years are concerned, the scope for intraregional trade appears limited to: (a) the partial replacement of external supplies of nitrogen (mainly from Japan) to Thailand, Malaysia and the Philippines by some of the offtake from the new Indonesian capacity; and (b) the purchase of new Bangladeshi and Sri Lankan output of nitrogen by India, at least until the latter's own new facilities come on stream and perhaps beyond. In addition, there could be some product specialization and/or exchange of intermediates, and some trade in products across borders without necessarily affecting net nutrient balance positions.

37. Meanwhile, the general external trade prospect is for a gradual decrease in imports of N as the output of the new facilities already under construction in many countries gradually closes the gap between domestic production and growing consumption in most countries. Unfortunately, this reduction of dependence on imports will probably be occurring concurrently with a gradual fall in world prices from their high 1974 levels, raising problems of competition in domestic markets for most countries in the group, and the more serious problems of external disposal for the few which will have gone into surplus by the end of the decade. Meanwhile, imports of phosphatic and potash nutrients should increase, since demand for the former is likely to grow faster than supply within the group while potassium salt production is not expected within the region in this decade.

38. The situation will change in the 1980s, when the pattern of intraregional (including subregional) and external trade will depend on several factors which remain difficult to quantify at this stage. The most important among these are the rate of expansion of demand in each country and the extent to which Governments, private investors and external sources of finance over the next few years will plan and initiate installation of new facilities to meet domestic fertilizer needs and/or to exploit raw materials endowments with export markets in mind. There are high risks involved in anticipating the export markets with respect to nitrogen, though not to phosphates or potash, without firm commitments in advance.

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39. ASEAN provides a good example of a subregion with a potential for trade-oriented development of the fertiliser industry. Within a subregional group such as ASEAN, the construction of large-scale national facilities, though necessary to avoid reliance on small, inefficient production operations, would result in national shortages and surpluses, especially if comparative advantage in raw materials endowment were to influence location decisions. However, subregional harmonization of investment planning in the fertilizer sector could match these up in an orderly way. Some investment decisions yet to be taken, along with the rate at which new capacity is put in place, the capacity utilization rates achieved, and the rates of growth of domestic demand levels could give the ASEAN subregion almost any balance in 1985, ranging from a deficit of 1.3 million tons N to a surplus of similar magnitude. The greater the degree of both plan co-ordination and trade on a subregional basis, the more likely it is that a zero balance will be approached and/or surpluses restricted to competitive operations.

40. If production targets were restricted to subregional self-sufficiency, a favourable scenario might feature Indonesia becoming self-sufficient and supplying its partners with nitrogenous fertilizers before further production facilities were brought on stream elsewhere. Indonesia would have a guaranteed market while the Philippines, Malaysia and Thailand would have guaranteed, reasonably-priced supplies. Additional nitrogen facilities would be located on the basis of economic criteria within a subregional arrangement providing also for specialization in phosphates and potash for the Philippines and Thailand respectively. The scope for possible export beyond the subregion, whether for profit or necessity, would also be borne in mind, as would the availability of cheap extra-subregional supplies, which would permit greater specialization within the subregion.

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41. Several other instances of existing inter-country co-operation, albeit of a bilateral nature, involve either India or the Philippines in association variously with Bangladesh, Burma, Sri Lanka, Pakistan or Indonesia. Although few, these activities represent a range of technical, financial and trade components of subregional co-operation, and their extension should be encouraged. They might be precursors of subregional collaboration in production and trade, and also of the possibly important intraregional associations which could be developed on a broader front.

42. The main basis of specialization by members of subregions such as these is their different endowment of raw materials. Natural gas reserves give some countries a comparative advantage in the production of nitrogen nutrients, while at least one country may have a virtual regional monopoly on potash. In such cases, co-operation might feature the exchange of one nutrient for another. The picture is more complex in phosphatic fertilizers, for which both rock and sulphuric acid are required, but this may make co-operation desirable among countries with different raw material inputs for the same nutrient.

43. Proximity, and thus relatively cheap transport for trade within the subregion, may be another factor, but a more important basis for specialization or manufacture away from domestic markets consists of the economies of large-scale production. These provide scope for at least the exchange of quantities smaller than the output of an (additional) domestic plant, and also for co-operation to facilitate the exploitation of comparative advantages through production for export beyond the subregion.

Conclusions

44. Several major conclusions emerge from the foregoing discussion. To begin with, domestic demand for chemical fertilizer must be encouraged in order to exploit the positive benefit-cost ratio to help ensure the rapid expansion of food output. Determined official policies, perhaps including interference with market mechanisms and the reorganization of existing distribution systems, will be necessary to bring this about. Moreover, demand at home and in countries containing potential consumers for surplus product must be predicted accurately and in advance of investment in expensive new capacity.

45. The world will be expanding its chemical fertilizer capacity rapidly over the next decade, especially in areas such as the Middle East, North and West Africa, Alaska, Venezuela and perhaps the North Sea. Meanwhile, although most traditional suppliers in developed countries are not expanding their export capacity, some will have to find new markets for output previously exported to new producers such as China. World prices are likely to be such that reliance by some developing ESCAP countries on the external sector either to offload domestic surpluses, whether temporary or generated intentionally for export, or to obtain imported supplies, may be foolhardy. Where economically feasible, production plans should be harmonized, demand information shared, and trade flows planned in concert and in advance. Furthermore, world and regional price and production trends need to be monitored closely to assist investment planning.

46. ESCAP countries with abundant natural gas are creating new capacity rapidly and will achieve surpluses in their nitrogen industries by the end of the present decade. Even without their own gas, some other countries will meet their own needs by importing or using less efficient indigenous feedstocks, leaving only the Philippines, Malaysia, Thailand and the Republic of South Viet-Nam with significant deficits. Self-sufficiency throughout the 1990s in each of the 11 countries studied would require construction of further capacity totalling about 16 million tons N and 6 million tons P_2O_5. As much of this would be located in suboptimal locations and some of it on inefficient scales, it would be preferable for some countries to maintain deficits in some fertilizer products, contributing to subregional, regional or international balance rather than national self-sufficiency.

47. Utilization of indigenous natural resources is the main factor making a fertilizer industry viable in ESCAP countries. They should be exploited as efficiently as possible, with relative transport costs dictating the appropriate siting of various stages of production between their location and that of the region's product markets. Moreover, the economies of scale and savings from the maintenance of continuous production at high-utilization rates are significant in chemical fertilizer industries, especially the manufacture of nitrogen. Taking advantage of these factors is likely to require at least subregional arrangements to share technology, to assist the development of raw materials

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and feedstock sources, to invest jointly in suitably located large-scale production facilities, and to trade in various combinations of natural resources, intermediate feeds and fertilizer products and compounds.

48. Among the approaches which might be adopted for the implementation of subregional economic co-operation, full-scale industrial integration would require plan harmonization, and would feature such techniques as free-trade agreements, forward purchase and supply contracts, and multilateral financial participation in subregional investments, as well as subregional shipping arrangements and co-operation in production technology, market development and raw materials exploitation. Each of these would be necessary to implement harmonized plans, and the achievement of each would be facilitated by commitment to the harmonization process.

49. Short of such a programme calling for comprehensive and formal intergovernmental agreement, co-operation might be stimulated and executed by sources of finance anxious to ensure long-term returns on their investment. Transnational companies based both inside and outside the region, international institutional lenders, domestic businessmen and quasi-public agencies within the subregion all have an interest in securing the benefits streaming from rational development of the fertilizer industry on a subregional basis, and in investing accordingly. By creating a non-discriminatory environment, governments could encourage such initiatives without committing themselves to formal agreements or erosion of sovereignty.

50. Moreover, Governments themselves could implement important co-operative activities without the framework of comprehensive plan harmonization. Separate arrangements might be made involving collaboration in such fields as economic analysis, production technology, stock management, and raw materials development. Even trade made necessary by unplanned temporary surpluses and shortages, and the removal of obstacles inhibiting rationalization of the industry's development could be included.

51. Among such schemes, the collection and analysis of country data and the related projection of supply-demand balances and trade possibilities are crucial. They should be implemented immediately, regardless of whether or not other subregional measures are adopted. In addition to their own benefits, intergovernmental contacts of this sort should enable individual Governments to take

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better account of external, especially subregional, developments in their own planning, and perhaps prepare the way for more fundamental co-operation at a later stage.

52. **Technical** and financial assistance should be drawn from within the region where justified. However, early external assistance is desirable to assist the development of natural resources and improve information flows and analysis, in order to expand the scope for intraregional co-operation. Assistance is also required for a range of programmes to raise the productivity of the existing facilities and ensure that of the new facilities in the region. International agencies engaged in both technical assistance and financial investment should co-ordinate their research and implementation closely.

Recommendations

53. Twenty four recommendations for further action by ESCAP member Governments, indigenous investors, researchers, and international advisory and financial institutions have arisen out of these conclusions and the more detailed investigations carried out under the UNIDO/ESCAP project. It is recommended that:

(1) Groups of ESCAP member countries which include deficit and surplus producers of various chemical fertilizer nutrients and products should give serious consideration to the harmonization of fertilizer production planning and the arrangement of future trade on a subregional basis, with appropriate pricing provisions and incentives to reduce uncertainty and ensure benefit for all parties.

(2) Private and institutional foreign and domestic investors in fertilizer facilities within the ESCAP region should be encouraged to consider the opportunities and need for subregional (and external) trade in order to ensure national allocation of capital and maximization of long-term profitability; and subregional investment in production facilities should be promoted.

(3) ESCAP member Governments should avail themselves of every opportunity to expand contacts with other countries, especially those with complementary chemical fertilizer prospects, by exchanging expertise and information and by making ad hoc subregional arrangements on particular issues such as stock management and market development.

(4) In order to promote intraregional trade and subregional co-operation, international agencies and member Governments should co-operate to improve fertilizer economic information services

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which would give producing and consuming countries the results of continuous monitoring of national, regional and world trends and prospects in the demand, supply and prices of fertilizer raw materials, intermediates, products and transport services.

(5) Economic studies should be initiated immediately by ADB, ESCAP and other international agencies working in concert on fertilizer price trends, raw materials price trends, forward market conditions, the scope for trade arrangements, and the availability and cost of ocean transport.

(6) (a) Efforts should be increased to develop potash mining and production of marketable potash salts in Thailand and Laos for the benefit of the whole ESCAP region and particularly to supply Thailand's ASEAN partners in exchange for other fertilizer nutrients;

(b) The development of the fertilizer industry and market in the Mekong riparian countries should be studied, the results of the study should be evaluated from the point of view of future regional co-operation, and appropriate sub-regional fertilizer policies should be encouraged.

(7) (a) A regional phosphate development programme should be commenced urgently to ensure concerted co-operative action in the ESCAP region as a whole, in addition to steps taken by individual countries, to mine and use phosphatic rock for fertilizer production;

(b) Long-term agreements should be reached to secure supplies of low-cost phosphate rock from countries within the ESCAP region (such as Australia) or from ECWA countries.

(8) (a) India and the Philippines should co-operate in the development of pyrites-processing and by-product sulphuric acid technology, and accord priority to the development of their phosphate industries;

(b) The Philippines should develop an export-potential in P_2O_5 based on sulphuric acid from copper-smelting, ensuring markets through bilateral trade agreements to meet the needs of Indonesia and other countries in the ESCAP region, particularly ASEAN members.

(9) (a) Assistance should be given to assessing the economic feasibility of the development of the gas-based nitrogenous fertilizer industry in Bangladesh;

(b) Trade arrangements should be concluded to enhance this industrial means of exploiting the indigenous resources, while other means should be sought in case of a temporary fertilizer surplus in Bangladesh.

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(10) Feasibility studies dealing particularly with the export market should be undertaken for Singapore, Brunei and Burma as soon as the results of more general studies on the world and regional market situation in N-fertilizers become available.

(11) In order to promote and co-ordinate the future development of the fertilizer industry in ESCAP countries on a regional and subregional basis, and to provide technical assistance and information required for national decision making, a regional fertilizer development programme should be established in the ESCAP region.

(12) Existing facilities in the ESCAP region should be expanded to form a regional catalyst development centre in order to assist member countries in research, production, standardization, quality control and training aspects of the use of catalysts.

(13) Model maintenance programmes should be implemented for the improvement of maintenance planning and organization in existing and new plants in the ESCAP region, and these programmes should be taken into consideration during negotiation on contracts for new plants.

(14) Two training programmes should be launched as extensions of existing training facilities to serve the fertilizer industry of the ESCAP region.

(15) (a) In order to facilitate the successful installation of new fertilizer facilities in the ESCAP region, a continuous dialogue should be commenced among representatives of companies having experience in contracting fertilizer plants, production units and single items of equipment;

(b) General guidelines should be prepared on contract formulation, pertinent international practices, sellers' and buyers' liabilities, etc.

(16) The exchange of regional teams for assistance in start-up operations should be organized to exchange experience on start-up operations and to facilitate technical assistance during the period of initial production in order to prevent the malfunctioning of new plants in the ESCAP region.

(17) A study should be conducted and a symposium convened to enable ESCAP countries to exchange experiences related to the production of blended and compound fertilizers with a view to the improvement of mixing-plant operations in the region.

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(18) A regional workshop should be convened to exchange experiences of management structures in existing ESCAP fertilizer plants, supported by a comparative study on management of highly efficient and lower-output plants, and including the elaboration of improved management structures for large and small plants.

(19) (a) General comparative studies should be expanded and a regional symposium convened on fertilizer marketing and distribution infrastructure and problems in ESCAP countries;

(b) A special study should be conducted on improved fertilizer bagging and bulk transport techniques in the region;

(c) Comparative economic studies should be expanded on ESCAP member Governments' fertilizer pricing policies and the optimization of subsidies and import taxes on fertilizers and fertilizer raw materials, in order to establish recommended value-to-cost ratios to help governments develop consistent and flexible relationships between fertilizer and crop prices.

(20) Research on the use of slow-release nitrogenous fertilizer should be intensified within the ESCAP region, with promising materials being tested and demonstrated at a regional meeting.

(21) (a) An appraisal should be made of the techno-economic feasibility of reconstruction and debottlenecking of the existing ammonia/urea plant in Thailand;

(b) A prefeasibility study should be conducted in the same country on the establishment of new production facilities for local supplies andpossibly export.

(22) UNIDO and the regional commission's secretariat should maintain contact with ESCAP member countries' Governments to facilitate and speed up requests prepared by countries and companies requiring assistance, and to help Governments identify the need for such assistance.

(23) External financial resources made available to the ESCAP region should be directed especially towards large export-oriented plants, the utilization of local raw materials, the encouragement of domestic investment, the expansion of consumption, the remedying of faults and shortages causing low productivity, and the provision of technical assistance before and after start-up.

(24) More moderate repayment terms should be adopted for loans to construct new facilities in developing ESCAP countries, and there should be extensive co-ordination among the various regional and external funding institutions.

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54. It would be desirable for the thirty-second session of the Economic and Social Commission for Asia and the Pacific to take note of the conclusions summarized in paras. 44-52; to commend in principle for the earliest consideration of its constituent members the recommendations in para. 53, especially that (no. 11) calling for a regional fertilizer development programme, and to call on its constituent members to make strenuous efforts to identify and participate in mutually beneficial, regionally or subregionally, co-operative solutions to the problems associated with the rapid development of the chemical fertilizer industry in order to meet the requirements of the ESCAP region. It should also authorize the Executive Secretary to take firm initiatives in implementing the recommendations calling for economic studies to assist trade and co-operation, a regional phosphate development programme, the exchange of experience in fertilizer plant management, and further work on fertilizer marketing and distribution (nos. 5, 7, 8, 18, 19); and request him to co-operate with the appropriate agencies and member Governments in the implementation of the other recommendations.

55. Meanwhile, the attention of UNIDO is called to its proposed major role in projects to implement many of the recommendations concerned with improving productivity in existing and new fertilizer facilities. Finally, all the recommendations are submitted to the World Bank Group, the Asian Development Bank, the International Fertilizer Development Centre at Muscle Shoals, the Food and Agriculture Organization and other international and regional institutions, for their earnest consideration of the roles they might play in co-operative efforts to assist the developing ESCAP countries in their national, subregional and regional development of chemical fertilizer production and trade.

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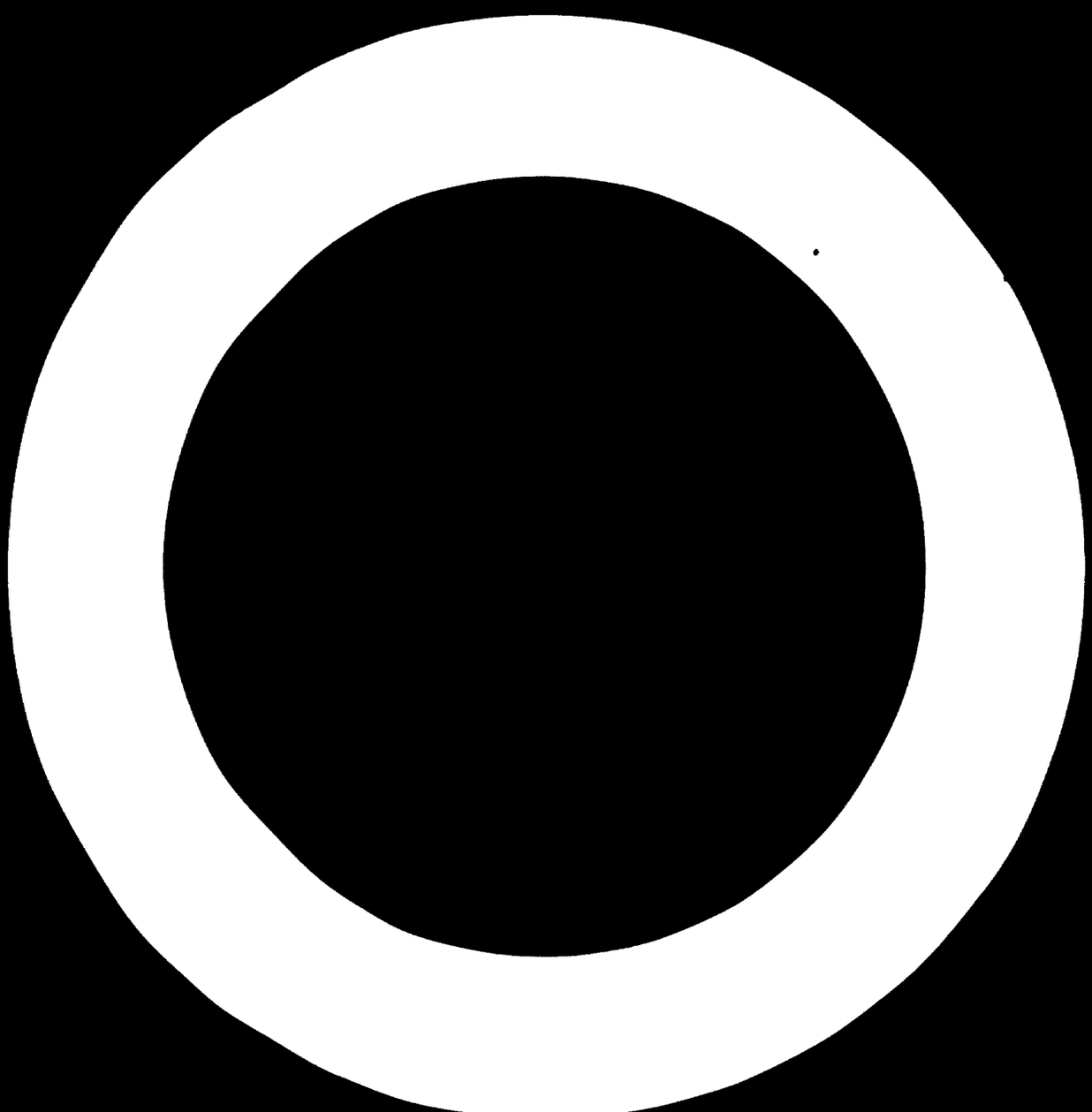

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/Chapter 8:

PART A: FERTILIZER PROBLEMS AND REQUIREMENTS

Chapter 1: Crisis and Outlook

1. In several developing countries over the past half-decade, chronic food-shortage situations have reached famine or near-famine proportions. This crisis became especially acute around 1973 when a period of adverse weather conditions harmed production of cereals in developed food-exporting countries as well as developing countries. Rapidly increasing oil and fertilizer prices, a world shortage of fertilizers resulting from previous reductions in investment in fertilizer projects, food-aid limitations, and sometimes already severe balance-of-payments deficits, combined to severely affect several developing countries of the ESCAP region. While food reserves were reduced to dangerous levels, high prices and short supply precluded the maintenance of fertilizer imports to raise or even maintain food production in subsequent years. As well as affecting food output, the fertilizer shortage has harmed cash crop production, a major source of foreign exchange for many of the countries.

2. Notwithstanding relatively low application rates in most countries of the region, as shown in table 1,[1/] fertilizer use for all of Asia and the Middle East (except the USSR), amounted to just over 13 million tons of nutrients (N, P and K) in 1973.[2/] This represented about 17 per cent of total world consumption applied to an area covering about 22 per cent of world agricultural land and containing almost 60 per cent of total population. For nitrogen alone, Asian use of 8.2 million tons N was 23 per cent of world consumption. Although at one time Asian imports accounted for half of world trade in nitrogen, their level has expanded quite slowly while exports have increased, so that by 1973 net imports were only 0.7 million tons N. The rapid recent growth in Asian output, which reached about 7.5 million tons N in 1973 compared with 3.5 million tons N six years earlier, has been contributed mainly by Japan so far.

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1/ The tables cited in the text are appended as Annex I, beginning on page 151.
2/ All tonnage figures used in this paper are metric tonnes.

For phosphatic nutrients, 1973 Asian use of just over 3 million tons P_2O_5 in 1973 was 14 per cent of the world total, while the region's production of 2.5 million tons P_2O_5 was 10 per cent. Potassium nutrient production was only 0.6 million tons K_2O, necessitating the net import of a further million tons.3/

3. To safeguard food supplies for the rapidly increasing populations in the developing countries of the ESCAP region, it is important to regain the momentum which the "Green Revolution" (initiated in times of very cheap fertilizers) had generated and to expand domestic food production to a level sufficient to remove the prospect of famine. The expansion of agricultural output is also necessary in order to promote rural development by raising the incomes of the small farmers who comprise a very substantial proportion of the region's population. As chemical fertilizer is an essential requisite, along with higher-yielding seeds, water and pesticides, for increased production of food and other agricultural commodities, disruptions in its supply or sharp increases in its price can impede development efforts seriously.

4. The acute shortage of fertilizers withessed during the period 1973-74 was accompanied by sharp increases in the prices of most fertilizer products, often compounded by increases in transport costs. By the end of 1973, f.o.b. prices in Western Europe or Florida were about twice their level in early 1972, and even greater increases in 1974 brought the price of bagged urea to almost seven times its early-1972 level. Meanwhile ammonium sulphate and triple superphosphate prices rose to almost six times their level of 30 months earlier, the diammonium phosphate price rose to almost five times, and even the cost of potassium chloride doubled. During 1975 most prices have declined, reaching about $US250/ton for DAP, $220/ton for urea and for TSP, and $100/ton of ammonium sulphate towards the end of the year.4/

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3/ For a more detailed outline of Asia and the world fertilizer market, see Tennessee Valley Authority (International Fertilizer Development Centre): An Appraisal of the Fertilizer Market and Trends in Asia, prepared for the US Agency for International Development, Asia(TV)01-75, Muscle Shoals, June 1975.

4/ British Sulphur Corporation: Monthly Price Reports.

5. Even at these high prices, increased chemical fertilizer application on paddy would usually remain desirable in terms of the economic return. For example, data collected in mid-1975, in the course of the UNIDO/ESCAP Priority Project out of which this paper arises, has indicated benefit-cost ratios of 2:1 and even 4:1 in South Asian countries. A 1974 FAI/FAO seminar reviewed field studies showing ratios of 2.7:1 in Bihar to 5.5:1 in Maharashtra, and even higher returns were found in some Indian states for crops other than paddy.[5/] Lower but still positive returns may occur when fertilizer use is based on general rather than soil-test recommendations, or when it is not accompanied by high cultivation practices such as weed-control. It appears also that increased fertilizer application is worthwhile with improved varieties of seed as well as with high-yielding varieties which require considerable irrigation. However, chemical fertilizer application is fairly new (or barely practised) in most districts of the developing ESCAP region, so more than a positive return may be required to allay farmers' fears and expand use on the scale necessary.

6. Moreover, the 1973/74 crisis contributed enormously to deterioration in the balances of trade and foreign exchange positions in many developing countries. This was accentuated by sharp rises in freight charges during the same period, when demand pressures caused by large wheat shipments by Australia, Canada and the United States exacerbated rising costs in the transport industry. In this situation many developing countries, particularly those most seriously affected, had to reduce imports even of some of their essential import requirements such as food and fuels in order to ameliorate their critical balance of payments position and foreign exchange crisis. As seen in table 6, the cost of imports of fertilizers in the developing Asian and Pacific region (except China and other centrally planned economies and Iran) rose from $US700 million to more than $ 1,850 million during the 1973/74 period. Excluding a few fortunate countries, the combined deficit in the balance of trade for the developing countries in the ESCAP region skyrocketed from $ 5 billion to $ 11 billion during the 1973/74 year. The prices of all fertilizers and freight costs fell drastically in 1975, but the damage to foreign exchange reserves had been done.

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5/ Herdt and Barker: "Possible Effects of the Fertilizer Shortage on Rice Production in Asian Countries"; Paper No. 74-23, presented at the Asian Productivity Organization Symposium on Interrelationship between Agriculture Inputs, Industry and Agriculture, Tokyo, Japan, 25 November-2 December 1974.

Imported supplies

7. Major suppliers of chemical fertilizers to developing ESCAP countries during the past decade are Belgium, Canada, the Federal Republic of Germany, Italy, Japan, the Netherlands and the United States. Nearly half of the nitrogenous fertilizers imported by the developing countries has come from Japan which, along with the Netherlands, the United States and Italy, has tended to dominate the import markets in the ESCAP region. Phosphate rock for the production of phosphatic fertilizers has been mainly imported from Jordan, Morocco and the United States, while Canada, the United States and the Federal Republic of Germany have been the major suppliers of potash fertilizers to developing ESCAP countries. Recent trade flows affecting developing ESCAP countries in each type of fertilizer are summarised in tables 2-5.

8. World production is expected to expand rapidly over the next few years, with a consequent lowering of prices from their high 1974 levels. In the longer run, however, considerable international restructuring of the industry is expected to continue, partly as a result of the phasing out of polluting industries in developed countries, partly as a reflection of the changing location of discovered raw material supplies, and partly due to the designation of fertilizers as a strategic commodity in many developing countries. Increasingly, developing countries will dominate the industry. Increases in most developed countries' production, particularly that of nitrogenous fertilizers, are likely to be mainly for domestic markets in these countries, and little increase in export potential is foreseen for most of the countries which traditionally have supplied developing Asia's fertilizer needs, as tables 6-8 show.

9. The unwillingness on the part of fertilizer producers in developed countries to expand fertilizer production for export purposes has been mainly due to:

(i) increased prices for raw materials and feedstocks, squeezing their profit margins;

(ii) acute fluctuation in fertilizer demand/supply balances and prices, leading an great profit instability to fertilizer-producing companies;

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(iii) stricter regulations and control over the environment;

(iv) continued inability of developing countries to finance imports of chemical fertilizers at prices considered reasonable to fertilizer exporters;

(v) the non-availability of cheap feedstocks locally; and

(vi) long distances from consumer markets at a time of high freight rates.

10. Even in those countries which do have export potential, prices of fertilizers and feedstocks are likely to continue to increase in the long run due to inflationary pressures. Further temporary declines, followed by only moderate increases are anticipated in the short term, and some analysts have estimated such prices at the end of the present decade as $US 210/ton for DAP, $ 140/ton for urea, $ 130/ton for TSP and $ 35/ton for ammonium sulphate (in constant 1975 dollar-terms). However, following such declines, world fertilizer prices are expected to trend upward in response to the high investment cost of new production facilities and continuous upward movements in raw material prices. Among other effects, this price trend should encourage the rapid expansion of production capacities in areas such as the Middle East, North and West Africa, Venezuela, Alaska and perhaps the North Sea, which are well endowed with petroleum and natural gas. The establishment or growth of production based on these feedstock sources will place more supplies of nitrogenous fertilizers on the world market during the 1980s and thus modify the upward price trend.

11. Exports from centrally planned economies have not been taken into account in the preparation of this paper. It should be noted, however, that more than 0.5 million tons of nitrogenous fertilizer products have been exported annually by Japan to China. This major regional consumer is increasing its degree of self-sufficiency, enabling Japan to divert some of its exports to other developing ESCAP countries. It is possible that the 13 new plants, each with the daily production capacity of 1,000 tons of ammonia and 1,660 tons of urea, now under construction in China may meet only partially the increasing demand for nitrogenous fertilizers expected from greater emphasis on expanded food production in that country. However, Japan is expected to continue to have an annual export surplus of

1.5 million tons N, at least until its older production facilities are scrapped.

12. Among other traditional suppliers to the Asian market, the US has been a net nitrogenous fertilizer importer itself during the past few years, and the possibility of its expanding production sufficiently to be able to export seems remote, although this depends on awaited congressional decisions on the prices of Alaskan and other natural gas for interstate commerce. However, US exports of phosphatic and potash fertilizers are expected to grow to meet the demand for them in developing countries which have still imbalanced N-P-K application ratios. Of the major nitrogenous fertilizer exporting countries of Western Europe, the Netherlands, Norway and the United Kingdom may in the future expand fertilizer exports to developing countries of Asia and the Pacific by utilizing oil and natural gas found in the North Sea. This expansion, however, will not be significant until the late 1980s, as definite plans for constructing new plants have yet been formulated. Meanwhile, the Federal Republic of Germany and France should continue to be sources of potash fertilizers, along with Canada; and Australia could become an important source of phosphates.

Domestic production policies

13. As observed earlier, the need for considerably increased application of chemical fertilizers is an important constraint on the expansion of food and cash crop production on Asian farms. Several factors have led developing countries to adopt policies aimed at the rapid expansion of domestic fertilizer production as the principle means of achieving the necessary increase in supply and utilization. These factors include:

(i) the possibility of inadequate world supplies available for import, as a result of the contraction of investment by traditional producing countries;

(ii) the fear that the decline in world prices which is now taking place will prove to be temporary and that as future shortages develop prices may fluctuate wildly around high levels;

(iii) high transport costs;

(iv) the chronic foreign exchange shortages which already exist in some countries, partly as a result of the recent fertilizer crisis;

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(v) the wish to exploit local sources of hydrocarbon feedstocks and other raw materials, partly by transforming them into fertilizers to meet their own or other countries' expanding demand.

14. This drive for at least partial self-sufficiency is especially marked in the ESCAP region, where the fertilizer industry has traditionally produced only a small proportion of requirements, and that often in small or otherwise inefficient plants producing inappropriate or high-cost products. Now most ESCAP member countries, especially those seriously affected by the world market supply and price situation in both fertilizers and raw materials, and those with local sources of low-cost hydrocarbon feedstocks, have stepped up their plans to create or expand their own production facilities, especially for nitrogenous fertilizers. Since these new plants entail huge investment costs, the programmes require the according of priority to financial support provided by governments or arranged by governments with financial organizations or governments outside the region. In many of the countries, the identification of problems and decisions for the rapid promotion of investment projects were made already during 1973 and 1974, with the result that a large number of ammonia/urea complexes, many of them based on low-cost indigenous natural gas, are already under construction in the ESCAP region.

15. In contrast to the medium-term outlook for nitrogenous fertilizers, most developing ESCAP countries will remain import-dependent with respect to phosphatic fertilizers. The national development of the phosphates industry is less feasible in the short term for most of the countries, since they lack sufficient indigenous sources of the necessary raw materials (rock phosphate as well as sulphur). However, rock phosphate of similar geological origin has been discovered in a few countries - namely Afghanistan, India, Iran, Pakistan and Sri Lanka - while Thailand, Laos and Malaysia also may be endowed with enough low-grade rock phosphate for development of indigenous phosphate industries in the longer term. Moreover, Australia appears to have discovered enough rock in Queensland to supply a significant proportion of developing Asia's needs, and a large mining and beneficiation project is now under way. Potash raw materials are even more scarce in the region at the present time. Development

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of this industry is likely to occur only in the medium to long term, and then probably only in the two Mekong riparian countries (Thailand and Laos) which have carnallite and sylvite deposits.

16. As well as hastening the establishment of new capacity, mainly for nitrogenous fertilizer production, developing ESCAP countries have responded to the recent crisis by taking steps to improve the utilization rates and productivity of existing fertilizer facilities. Many of these have been operated very inefficiently, resulting in average utilization rates of 60 per cent or even less in some cases. The major bottlenecks to improving the rate of utilization of capacity at the inefficient fertilizer plants in the region appear to be:

(i) lack of steady supply of raw materials and feedstocks,

(ii) electric power shortages,

(iii) inadequate maintenance programmes, particularly those of preventive nature,

(iv) shortages of spare parts,

(v) shortages of skilled, technical and managerial manpower,

(vi) antequated plants and equipment, and

(vii) the use of high selling prices (sometimes reflecting high world prices) and consequent poor offtake by farmers.

17. Along with national efforts, various international agencies either individually or jointly have been increasingly active in assisting developing ESCAP countries to "debottleneck" the operation and management of existing fertilizer plants. Their efforts have included the identification of critical bottlenecks; the formulation of debottlenecking plans and programmes; the provision of the foreign exchange necessary to import needed inputs; the strengthening of in-plant technical and supervisory training programmes; the provision of World Bank loans for improving the economic infrastructure which is necessary for uninterrupted operation of the existing fertilizer plants; action to help solve distribution and marketing problems; and the organization of conferences, seminars and workshops to draw greater attention of the community of nations to the problems of underutilization of fertilizer production capacity. The following chapter 2 describes the more important international institutions and programmes which have been invoked to address the fertilizer problem.

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18. Developed countries, too, have assisted developing ESCAP countries in making fuller utilization of the existing fertilizer production capacities by providing loans and technical assistance. Such bilateral assistance has come mainly from those developed countries which export fertilizer plants and equipment as well as technical know-how. In addition to supplying of fertilizers under bilateral aid programmes, developed countries have also participated in the International Fertilizer Supply Scheme to provide emergency assistance to developing ESCAP countries which need fertilizers but lack the necessary purchasing power, especially in the form of foreign exchange. Unfortunately, these efforts proved inadequate to close the gap between minimum requirements and supply even in the short run; and the more effective of the fertilizer assistance measures of developed countries and international agencies are those which have helped individual developing countries generate new fertilizer production of their own.

Expected difficulties

19. The tasks facing developing ESCAP countries which have adopted policies of partial self-sufficiency are therefore two-fold:

(i) to improve the utilization of existing fertilizer plants; and

(ii) to increase the production capacities in the region.

Both require the firm commitment of developing countries, as well as the ready financial, technical and managerial assistance by developed countries and international organizations. In addition, the new capacity programme requires the forecasting of fertilizer demand/supply balances at the global, regional and national levels, the development of national and regional fertilizer programmes, and the political commitment of both developed and developing ESCAP countries to co-operate and co-ordinate in chemical fertilizer production and distribution on an economic basis. Unfortunately, up to now relatively little attention has been paid to the development of the industry in the ESCAP region on the basis of comparative advantage, since the external assistance has been rendered to individual countries and their own plans formulated without a commercial scheme to ensure an optimum production pattern in developing ESCAP countries as a whole.

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20. With the rather rapid expansion programmes currently underway and firmly planned in nitrogenous fertilizer production capacities in developing ESCAP countries, the group as a whole, excluding China, is now expected to experience a more or less balanced demand/supply situation by 1979/80, though with shortages reappearing by 1984/85. This favourable balance forecast was made by both an Expert Group meeting held as part of the UNIDO/ESCAP Priority Project and the second session of the FAO Commission on Fertilizer in mid-1975. It is predicted on the assumption and hope that developing ESCAP countries will be able to improve the capacity utilization of their fertilizer plants to achieve an average of 80 or 90 per cent. The new capacity programmes will bring many countries close to the level of self-sufficiency in nitrogenous fertilizer supply during the 1978-1982 period. Hence further expansion of production should be based on realistic estimates of the attainable further growth of fertilizer use in the region. Countries where surplus or near-surplus conditions are expected to apply at the beginning of the 1980s include Indonesia, Iran, the Republic of Korea, Afghanistan, Bangladesh, Pakistan, Sri Lanka and perhaps India. Some of these will soon be able to export significant amounts of nitrogenous fertilizers, and others may be in a similar position if their effective domestic demand cannot be expanded as quickly as output once present dificits are met.

21. However, deficits could persist in some countries (especially large ones such as India), if growth in output does not occur to the extent expected, or if demand grows faster. As far as production is concerned, there is now serious doubt on the part of some analysts in developed countries and international organizations that the anticipated high rates of capacity utilization will be reached by developing ESCAP countries by 1979/80, due to the long-term nature of the technical and managerial bottlenecks observed at many fertilizer plants now operating and foreseen for those under construction. Several countries lack both the necessary assortment of raw materials and the foreign exchange required to acquire them, while almost all are dependent on the external supply of technical and financial assistance to plan, finance, construct and operate new national facilities involving difficult technology and substantial capital commitments.

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22. Moreover, it can be argued that the projections of demand currently being used by planners may be too conservative. On a more realistic view, it is alleged, fertilizer consumption on Asian farms will expand quite rapidly and bottlenecks in the distribution system will be overcome. There may be two main reasons for adopting higher demand projections. First, government policies concerned with raising food output on a massive scale are likely to place increasing reliance on giving farmers readier access to essential inputs such as fertilizer, the per hectare application of which is now rather low by international standards (as table 1 shows). Second, although the "VCR" - the ratio of the value of the extra yield produced through fertilizer application to the cost of this input - has fallen to unfavourable levels for some crops, it is expected to rise in the short-term as relative prices of food and agricultural commodities rise while fertilizer prices are moderated to reasonable levels by the expansion of supply. Insofar as these and other factors permit or cause effective demand to rise more rapidly than anticipated, additional production facilities will be needed if appropriate degrees of independence from external suppliers are to be maintained.

23. On the other hand, surpluses may be generated if the demand projections on which new investment was based prove to have been too optimistic. The difficulty of estimating the future growth of consumption is discussed in chapter 3 below, along with other demand considerations. It should be noted here however that except where vigorous rural development programmes are already under way there will be major difficulties in translating requirements into effective and satisfied demand. Apart from problems of acceptance at farm level, the distribution system in all these countries will need to be improved in order to handle tremendous amounts of fertilizers, in some cases double the quantities presently traded. Better organization and the development of infrastructure will be necessary, while flexible pricing policies taking the increased fertilizer supply into account will have to be adopted by governments to ensure that consumption occurs and to safeguard the effective use of the new capacity being installed. These and many other common problems are already evident in countries which have begun their own independent development of nitrogenous fertilizer production.

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24. Surpluses may also occur in small countries for production reasons, regardless of the rate of expansion of domestic consumption. The successful implementation of present production plans would produce excess supply in the smaller countries whose domestic market requirements cannot absorb the offtake of the large plant sizes needed in order to obtain scale economies in the production of chemical fertilizer products, particularly the high-nutrient and easily applied ones. Surpluses of a temporary nature may even arise in large countries since consumption growth is relatively steady while production expands by surges as each large new plant is brought on stream. It is probable that some of the expensive plants already under construction or planned may face the problem of either finding export markets or operating inefficiently below nameplate capacity once the immediate shortage is overcome about 1980. In a few cases plant construction is being made contingent on the identification of export markets, but more often the expansion of capacity is likely to occur without precise assessment of either domestic or export demand for its output.

Need for co-operation

25. Thus developing ESCAP countries are faced with several conundrums in the absence of good projections of chemical fertilizer supply and demand in both their own and the world markets. If production increases occur more slowly than expected, while consumption bottlenecks are relieved, a shortage situation will reoccur - to the countries' great discomfort if the world price is high or supply low. On the other hand, domestic plans to increase production may prove relatively more successful than efforts to expand demand, with equally serious consequences for plants unable to produce for export at costs competitive with what could be low world prices. The former situation would cause a recurrence of the 1973/74 crisis, while the latter would require subsidies and deny superior alternative investment opportunities, costs which the countries concerned can ill-afford to bear.

26. The pursuit of a middle path avoiding either of these extremes will require a much higher level of both information and active co-operation than is presently available. It is the purpose of the present paper to suggest ways in which regional and subregional economic and technical

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co-operation might not only help developing ESCAP countries avoid the extreme paths, but also deal with shortages and surpluses which will occur anyway. As well as its general function of improving information on external plans and actions, **intercountry** co-operation should provide the countries with direct solutions to particular problems which feature in the short-term outlook. These susceptible problems include:

(i) the danger that world supply and price trends may inhibit exports from new Asian plants and even make their offtake for domestic markets uncompetitive with imports;

(ii) the immaturity of the relevant industrial sectors and background in appropriate scientific and technological research and development of most countries;

(iii) lacks or shortages of indigenous raw materials and hydrocarbon feedstocks;

(iv) domestic markets which are too small to capture the economies of large-scale production and the difficulty of programming the introduction of successive new facilities so as to just match the growth of effective demand;

(v) the high investment requirements of new fertilizer facilities in capital-scarce economies with many competing uses for financial resources, and the need to attract external finance;

(vi) relatively low rates of utilization of capacity and other factors producing high-cost output from developing country plants; and

(vii) inadequate projections of domestic and export demand for each country over the long gestation periods which new construction requires.

27. As noted, the likelihood of these and other problems inhibiting the orderly development of national fertilizer industries over the next decade forms an important part of the short-term outlook. It is too early to judge whether developments within the ESCAP region over this period will readily include the sort of regional and subregional institutions, programmes and decisions which can contribute to their solution. The limited nature of the few bilateral arrangements already in hand in the

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fertilizer industry, and the slow progress made generally on industrial integration in this and other developing regions, provide no cause for optimism. Nevertheless, it may be expected that the very "strategicness" and the huge size of the fertilizer industry will lead governments to consider regional or subregional approaches which will offer secure supplies at more reasonable prices than either free-trade or autarchic alternatives.

28. Following a discussion of international activities in the following chapter, this Part A is concluded with more detailed consideration of both the importance and difficulty of accurately estimating demand. Part B (chapters 4, 5 and 6) then examines supply conditions and constraints in a selection of developing ESCAP countries, including both economic factors and projections of output levels by the end of the present decade and beyond. This facilitates the consideration in Part C (chapters 7, 8 and 9) of various possible supply-demand balance situations and their implications for the attainment of self-sufficiency, interregional trade and explicit economic co-operation among groups of developing ESCAP countries. Finally, and on the basis of the foregoing discussion, Part D (chapters 10, 11 and 12) makes recommendations with respect to subregional co-operation, the improvement of plant productivity and other requirements for technical and financial assistance to promote the development of an efficient chemical fertilizer industry in the region.

/Chapter 2:

Chapter 2: International Responses

Food conference and FAO activities

29. Partly to assist national efforts to expand local production, and partly to fill the gap between requirements and availabilities on an emergency basis, a wide range of international institutions and activities have been mobilized over the past two years. The most important global event, and a catalyst for much other activity and institution-building besides, was the World Food Conference in Rome in November 1974. This encouraged and expanded the ongoing work of the Food and Agricultural Organization (FAO), the United Nations Industrial Development Organization (UNIDO), the World Bank Group and other international agencies, as well as establishing new fora and programmes to relieve the temporary situation and to expand food production in the longer term.

30. The FAO has provided a focus for the immediate international response to the 1973/74 crisis. The International Fertilizer Supply Scheme (IFS Scheme) was established by the FAO in July 1974 at the request of ECOSOC and the FAO Council with a mandate to embark immediately on:

(i) a series of missions to assess the supply situation in developing countries, particularly the most seriously affected (MSA) countries;

(ii) an assessment of the availability of fertilizer in industrialized producer-countries;

(iii) the mobilization of financial resources and the making of arrangements to procure and ship fertilizer to needy developing countries;

(iv) development of a clearing-house function on the basis of a supply and demand information system; and

(v) initiation of "debottlenecking" actions to expand domestic production in a few developing countries.

The practical response to the international efforts by potential donor countries has so far been limited to emergency operations of a short-term nature. But in the very short term there is little that can be done to relieve the situation in the most seriously affected (MSA) countries.

31. The IFS Scheme reported in April 1975 that, despite increased bilateral fertilizer assistance and the operations of IFS Scheme that had been mounted

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to alleviate supply problems in developing countries for the remaining part of the fertilizer year 1974/75, it was evident that MSA countries would not have at their disposal during this year quantities of fertilizer corresponding to the level of use in 1973/74 plus a normal growth rate. The IFS Scheme feared that the 33 MSA countries would suffer a shortfall of 337,000 tons of plant nutrients in the current fertilizer year, and it was then too late to take any action which would make this good in the remaining part of the year to avoid a reduction in agricultural output equivalent to an estimated 2.7 million tons of grain. The fertilizer import requirements of MSA countries, on which the most of the work of IFS Scheme had been focused, would amount to approximately 3.2 million tons of plant nutrients for the fertilizer year 1975/76, and 75 per cent of these needs were in Asia.[1/] Table 7 summarizes the IFS Scheme's supplies to FSCAP member countries in 1974/75.

32. With a view to dealing with the longer term problem, a Commission on Fertilizers (COF) was established by the FAO Council in November 1973, on the recommendation of an ad hoc intergovernmental consultation on fertilizers with participation from governments, industry and agencies. The Commission was set up to keep the international fertilizer situation under continuous review and to consider any special difficulties which might arise in relation to production, consumption and trade. When it met in July 1974, the COF endorsed the establishment, and accepted responsibility for supervision, of the IFS Scheme and also proceeded to review:

(i) the current market situation, trends, and prospects for fertilizer supplies and prices;

(ii) measures required in developing countries to fully utilize existing capacities and to expand them; and

(iii) the availability and prices of raw materials in finished fertilizer in selected region in order to determine the implications of long-term trends for developing countries.

33. Subsequently, the World Food Conference requested the COF to define a "world fertilizer policy", based on an "authoritative analysis of the long-term fertilizer supply and demand situation". This was undertaken quickly and

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1/ International Fertilizer Supply Scheme: Report, FAO, April 1975 (AGS:F/75/5).

formulated in time for the June 1975 session. The report emphasized that without appropriate action there was no guarantee that the cyclical fluctuations which had characterized the fertilizer market in the past would not recur to the distress of either fertilizer users or the industry, or both. Much greater attention must be given in the developing countries to expansion and intensification of the use of fertilizer and other improved farming practices including high-yielding crop varieties. It suggested that the over-all objectives of a world fertilizer policy should be to define actions necessary to ensure that all farmers had continuing access to adequate sources of supply of fertilizers at reasonable prices as needed to meet requirements for production of food and other agricultural commodities, and that a maximum of resources - physical, financial and human - were mobilized to promote the more extensive and intensive use of fertilizer, particularly in the developing countries.

34. The COF report then proposed in detail two specific short-term and eight longer-term actions for helping to solve problems in the developing countries. The short-term recommendations were:

(i) the strengthening of the IFS Scheme through increased contributions to its Fertilizer Pool, and

(ii) expansion of bilateral fertilizer aid;

while the action which should be taken to deal with the longer-term problem included:

(iii) development of a better intelligence system for the gathering, storage retrieval and analysis of fertilizer information;

(iv) an intensive study to develop more reliable means of forecasting future supply, effective demand and requirements for fertilizer;

(v) an international fertilizer agreement, possibly incorporating a buffer stock;

(vi) long-term contracts between importers and exporters;

(vii) technical and financial assistance in the establishment of additional fertilizer production capacity in developing countries, including joint ventures;

(viii) additional efforts to assist developing countries to improve the rate of utilization of existing production capacity;

/(ix)

(ix) further technical and financial assistance to increase fertilizer use through the development of promotional and marketing infrastructure; and

(x) increased efficiency of fertilizer use.

35. Several other institutional changes have involved the FAO. One new organ, established by the FAO Council somewhat at the suggestion of the World Food Conference, is the Committee on World Food Security. Its task is to review continuously the food demand, supply and stocks situation, evaluate the adequacy of stock levels, review steps taken to implement the proposed International Undertaking on World Food Security, and recommend short- and long-term policy action to ensure adequate cereal supplies for minimum world food security. Another aspect of world food security which the Conference considered was the need for FAO to ensure its capacity to organize the proposed Global Information System and Early-Warning System in Food and Agriculture. Among specific projects under consideration for execution by FAO in the field of fertilizers has been a Survey of Soil Fertilities with particular emphasis on traditional methods and the use of organic manures. This project, execution of which has now commenced in co-operation with ESCAP, will include an intercountry network of research and demonstrations for improving soil fertility with emphasis on organic recycling.

36. More autonomous, but with its directorate based at the FAO's Rome Headquarters, is the World Food Council, established by the United Nations General Assembly on the initiative of the World Food Conference. The Council is to review all aspects of major problems and policy issues affecting the world food situation and to recommend further remedial action including an integrated approach among governments, United Nations bodies and regional agencies. Reporting to it is another committee established on the initiative of the World Food Conference - the Committee on Food Aid Policies and Programmes. Its purposes will be to evolve and co-ordinate both short- and long-term food aid policies, to provide a forum for intergovernmental co-ordination, to review general trends in requirements and availabilities, and to recommend improvements in aid policies' priorities, commodity-composition, etc. As well as advising the COF, the Council is expected to tender advice to the new International Fund for Agricultural Development (IFAD). The setting up of this fund emerged from various 1974 proposals (including those of ECAFE and Sri Lanka) for a world fertilizer fund. Favouring a broader approach, the World Food Conference resolved that the Council should set up a fund which would cover various aspects of agricultural development and include a "fertilizer window" among its activities.

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UNIDO activities

37. The main executing agency for the present priority project has a longer history of work on fertilizers than most other institutions. The Fertilizers, Pesticides and Petrochemicals Industries Section of its Industrial Technology Division and other UNIDO units have rendered technical assistance to the development of the fertilizer industry in many developing countries and have participated actively in the preparation for international conferences and the work of other agencies. In view of the worsening crisis over 1973-74, UNIDO has found it necessary to overhaul and speed up its fertilizer development programme for the coming years. Guidelines for this have been set out in several papers[2/] and a new programme of work and co-operation was launched at the Second International Industrial Development Conference, held at Lima in March 1975.

38. The Conference approved a comprehensive programme of follow-up activities named "Declaration and Plan of Action on Industrial Development Co-operation". This indicated the need for urgent action on a global scale regarding certain priority sectors, of which the chemical fertilizer industry was identified as one of the most important, and established a target for industrialization of developing countries, namely 25% by the year 2000. For this target to be achieved, an all-out effort would have to be launched immediately to co-ordinate, inter alia, the exploration of natural resources; the exchange of raw materials; the interchange of know-how, the provision of finance, the engineering of plants and infrastructure, the production and/or procurement of equipment; the optimization of production programmes and marketing; and the establishment of training programmes.

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2/ Especially UNIDO: Fertilizer Industry: Present Situation and Prospects for Development and International Co-operation, January 1975, Vienna.

39. The proposed action of UNIDO on these topics includes plans to organize consultations on an ad hoc basis in order to gather the relevant data and information; to ascertain and discuss opportunities for co-operation; and to promote negotiations, agreements and special arrangements for international co-operation among developing and developed countries. The Priority Project Programme in this respect is in line with these principles. On a broader front, full implementation is scheduled to occur in 1976 and 1977 on the study of sectoral development on a global scale, including:

(i) total world requirements of fertilizer nutrients (N, P and K), taking into account world population growth, improvement of the dietary and living standards, and total world food needs of the world, broken down between developed and developing countries;

(ii) the requirements of the developing countries by region;

(iii) the raw material situation and markets in developing countries, including the use of flared natural gas, low-grade phosphate rock and potash deposits;

(iv) a strategy and a plan of action linking major consuming-countries and countries with large amounts of low-cost raw materials in the developing world;

(v) design and engineering capacities in developing countries;

(vi) capital requirements and how to meet them;

(vii) transport and marketing, distribution and efficient usage of fertilizers; and

(viii) the management of large enterprises.

40. The general outline of a plan of action for this programme has already been prepared. It includes (a) the establishment of an expert group of about 10 high-level planners or engineers working for development of the industry in developing countries together with experts from developed countries, engineering and contracting firms and financial institutions; (b) groups of planners and experts for each of the ESCAP, ECWA, FCA, ECE and ECLA regions; and (c) various preparatory exercises by UNIDO including, in the organization's current programme of UNIDO activities:

/(i)

(i) assistance for bringing existing fertilizer plant capacities up to full production;

(ii) continuation and formalization of the UNIDO-FAO-IBRD Working Group;

(iii) the establishment of regional fertilizer development centres;

(iv) the highlighting of technologies for use of alternate feedstocks and preparing models based on gas, oil, coal and electricity; and

(v) participation in the World Food Council, the IFAD, the COF and the IFS Scheme;

and three further exercises now being proposed:

(vi) the establishment of a UNIDO-USSR Joint Centre for Fertilizer Development;

(vii) participation in the International Fertilizer Development Centre (TVA) and co-operation in the work of the IBRD Fertilizer Unit; and

(viii) the establishment of a fertilizer information and intelligence unit to carry out the Resolution III of the World Food Conference.

This programme is expected to provide a continuous link between UNIDO and ESCAP for the mutual benefit of the latter's member countries in the development of fertilizer production and distribution.

Inter-agency groups and fund sources

41. Several "food crisis" institutions have been established as co-operative ventures among international agencies. One of these which was set up on the proposal of the World Food Conference is the Consultative Group on Food Production and Investment in Developing Countries (CGFPI). The Group comprises representatives of bilateral and multilateral donors, as well as representatives of developing countries themselves and is staffed jointly by FAO, UNIDO and IBRD. Its function is to increase, co-ordinate and improve the efficiency of financial and technical assistance to agricultural production in the developing countries. There was already a Consultative Group on International Agricultural Research (CGIAR) and the Conference suggested that the same approach should be extended to other sectors such as extension, agricultural credit and rural development.

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42. For some years before the recent crisis and consequent activity there had been an ad hoc arrangement among FAO, UNIDO and IBRD on the financing of fertilizer projects. Following the World Food Conference this has been formalized as the FAO/UNIDO/IBRD Working Group to ensure co-ordination between the programmes of these agencies in the channelling of assistance to developing countries for the improvement and establishment of fertilizer plants. The Conference recommended that it should also assist developing countries to improve the efficiency of their fertilizer plant operations, complementing the work of the CGIAR. Meanwhile, the World Bank has been co-ordinating its activity with the IMF through the IBRD-IMF Development Committee. Established by the two major financial organizations to serve broader development purposes, this committee was requested by the Conference to review the adequacy of external resources available for food and input procurement and investment. It should also collaborate with the CGFPI in considering measures to achieve the required volume of resources transfers.

43. The co-operative activities of the members of the World Bank Group with other international agencies are only one aspect of the very substantial programme which has been developed by the Fertilizer Unit of the Bank's Industrial Projects Department. Over the past year a more detailed and definite operational programme has been developed, based on needs identified in mid-1974.[3/] Meanwhile, the first half of the present decade has already seen the Bank's investment of well over $US 500 million in fertilizer projects in developing ESCAP countries. The major beneficiary has been India, but projects have also received significant assistance in Indonesia, Pakistan and Bangladesh. The Bank's bilateral assistance to date, along with flows of suppliers' credit and long-term loans from the ADB, the United States and the Federal Republic of Germany, are summarized in table 10.

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3/ In May 1974 the World Bank produced a comprehensive document, Fertilizer Requirements of Developing Countries, Report No. 446 (confidential), and has subsequently complemented it with a Revised Outlook in 1975, Report No. 830 (confidential).

44. Experiences of providing loans for the construction of new fertilizer production facilities in developing ESCAP countries have shown that the recipient countries have not been able to utilize such loans effectively, and that long delays have occurred in bringing plants on stream. Most of the causes for this appear to be related to conditions in the recipient countries. These problems, which are discussed in more detail in Part B of this paper, concern such aspects as port and land transport facilities, power and water supply, technical personnel, spare parts, distribution systems, and bureaucratic procedures. Increasing awareness of such problems has led developed country and international agency donors to lay more emphasis on a package approach to investment, whereby loans cover many elements of infrastructure, distribution and ancillary facilities and require the integration of fertilizer programmes into over-all industrial and other development plans.

45. Aside from these problems in the recipient country, however, some donor countries still tie their loans to the purchase of major construction materials and equipments manufactured in their own countries. Tied loans of this nature not only decrease the capability of the recipient to purchase appropriate plant and equipment at competitive prices, but also increase the dependence of the recipient on the developed countries providing such loans. It is a welcome trend that most developed countries have now increasingly been untying their long-term governmental loans to developing countries. Nevertheless, there are only a limited number of fertilizer plant and equipment manufacturers in the world, and the recipient countries tend to take their imports from those firms with which they have had experience in operating their existing fertilizer plants.

46. The terms and conditions of bilateral loans from donor countries have tended over the years to become softened in accordance with resolutions adopted by OECD-DAC member countries and in General Assembly sessions. However, those of multilateral loans provided by the IBRD, the Bank's International Finance Corporation (IFC) and the ADB have not become easier to recipients. Indeed, in recent years these have turned even harder, reflecting the tighter international money market. As long as the international financing agencies continue to depend upon the commercial capital market in replenishing their major shares of financial resources or increased

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lending activities, developing countries will have to borrow at rates of interest which are higher than those paid for bilateral loans from developed countries.

47. The International Development Association (IDA) and the Asian Development Fund (ADF), soft-loan windows of the World Bank Group and the ADB respectively, have financed a limited number of projects in developing ESCAP countries, but such loans have been confined more or less to projects for economic and social infrastructural development. Except for a very few cases, industrial development projects such as the installation of fertilizer plant and equipment have not been covered by such loans. The oil facility and the extended facility created in the IMF after the petroleum price increases of 1973 and 1974, have been utilized mainly by the MSA countries in the developing world in order to relieve their balance of payments deficits. These facilities have not been made available to non-MSA countries nor for long-term development purposes.

48. Developing countries thus have no access to financial loans provided on relatively easy terms and conditions, other than those provided bilaterally by developed countries and some oil-exporting countries for expanding domestic fertilizer production capacities. This is the principle reason why the 30th Commission Session of the ESCAP in April 1974 endorsed a resolution calling for an early establishment of the World Fertilizer Fund (WFF), and why the developing world generally has been calling for the establishment and early implementation of the IFAD.

49. Following its endorsement by the delegates of a majority of developed and developing countries at the World Food Conference, the IFAD will provide both financial and technical assistance to developing countries for increasing food and agricultural production. It is very much hoped that it will provide such assistance on terms and conditions closer to those made possible by the IDA and the ADF rather than those adopted in normal IBRD, IFC or ADB lending operations. With the announcement made recently by the United States and the European Economic Community (EEC) in support of the IFAD, the earlier fear that it might never be started has now disappeared and its establishment has become a matter of time. Some oil-exporting countries are expected to join traditional donors in contributing financial

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resources: the pledging meeting of countries interested in supporting the IFAD took place in Geneva, Switzerland in October 1975 with reasonable success, although it is yet to be decided how much will be subscribed and loaned to the IFAD during its initial operating phase. Its financing and technical assistance activities will be encouraged to be well co-ordinated with those of FAO, the World Bank Group and the regional development banks in Africa, Asia and Latin America, as well as with those of the European Development Fund (EDF) of the EEC, the Arab Fund for International Development (AFID) and other multilateral financial agencies. Urgent and comprehensive international action on the IFAD's establishment and operation should provide significant relief for developing countries' fertilizer problems.

Regional Co-operation

50. The financial and technical assistance on fertilizer production so far provided by developed countries, oil-exporting countries and international financing agencies, regardless of the terms and conditions of such assistance, has been mainly in response to individual requests of developing countries for increasing domestic fertilizer production. There has been no conscious effort by these donor countries and international financing agencies to promote planned regional development of fertilizer production capacities, and neither the IBRD nor the ADB has yet financed any fertilizer industry development project in a developing ESCAP country with a view to promoting regional co-operative arrangements in this or allied sectors.

51. It is true that the ADB was interested in the identification of regional projects in the field of fertilizers and other industrial sectors, as evidenced by its financial contribution some years ago to the Asian Industrial Survey undertaken by ESCAP. However, the interest of the regional bank lessened when none of the ESCAP member countries produced any concrete action for setting up regional co-operative projects in industrial development. Its lending activities to increase bilateral co-operation between two of its developing member countries in the petro-chemical industry also did not produce the originally intended results, as the domestic market for each product to be exchanged for the other expanded too rapidly in each of the respective countries, leaving them with no export surplus available for one another.

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52. There is now a renewed interest however, on the part of the ADB as well as the IBRD, in promoting regional co-operation in industrial development including fertilizers, whether on a bilateral or a multilateral basis. In response to the request from the CGFPI, the World Bank has already embarked on the development of a regional plan for fertilizer industry development in Southeast Asia. Meanwhile the ADB has indicated (in the course of the Priority Project out of which the present paper arises) that it will collaborate with ESCAP and UNIDO on their development of a conceptual framework for regional fertilizer development plans or programmes for Southeast Asia and South Asia.

53. Apart from the new focus just referred to, and some regional projects of the FAO's regional office in Bangkok, attention to problems of fertilizer industry development on an intercountry basis has been mainly given by the United Nations regional commission. The interest of the Asian Industrial Survey for Regional Co-operation in the fertilizer industry has already been mentioned.[4/] A similar emphasis on the scope for subregional integration in this industry had been laid also by the United Nations Team's Report on Regional Co-operation in ASEAN earlier in the decade.[5/] More recently, in response to the emphasis placed on fertilizer problems by member countries at the 30th Commission Session in 1974, the ESCAP Secretariat established its own Task Force on Fertilizers to initiate and co-ordinate projects conducted by itself and in conjunction with other agencies. Both FAO and UNIDO are represented on the ESCAP Task Force, which has now broadened its interest to include other agricultural chemicals such as pesticides.

54. The UNIDO/ESCAP Priority Project from which the present paper arises has been the first exercise to be undertaken since the ESCAP Task Force was established. Funded by the United Nations Development Programme, it has been undertaken by a team based on the Development Planning Division of ESCAP and the Fertilizer, Pesticides and Petrochemical Industries Section of UNIDO.[6/] Several other projects are already under way or in final planning

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4/ Bos, H.C., et al., Report of the Asian Industrial Survey for Regional Co-operation, prepared under the auspices of ECAFE on request of the Asian Industrial Development Council, IDC (9)/1, New York, 1973

5/ United Nations Team (led by G. Kansu): Regional Co-operation for ASEAN, London, 1972.

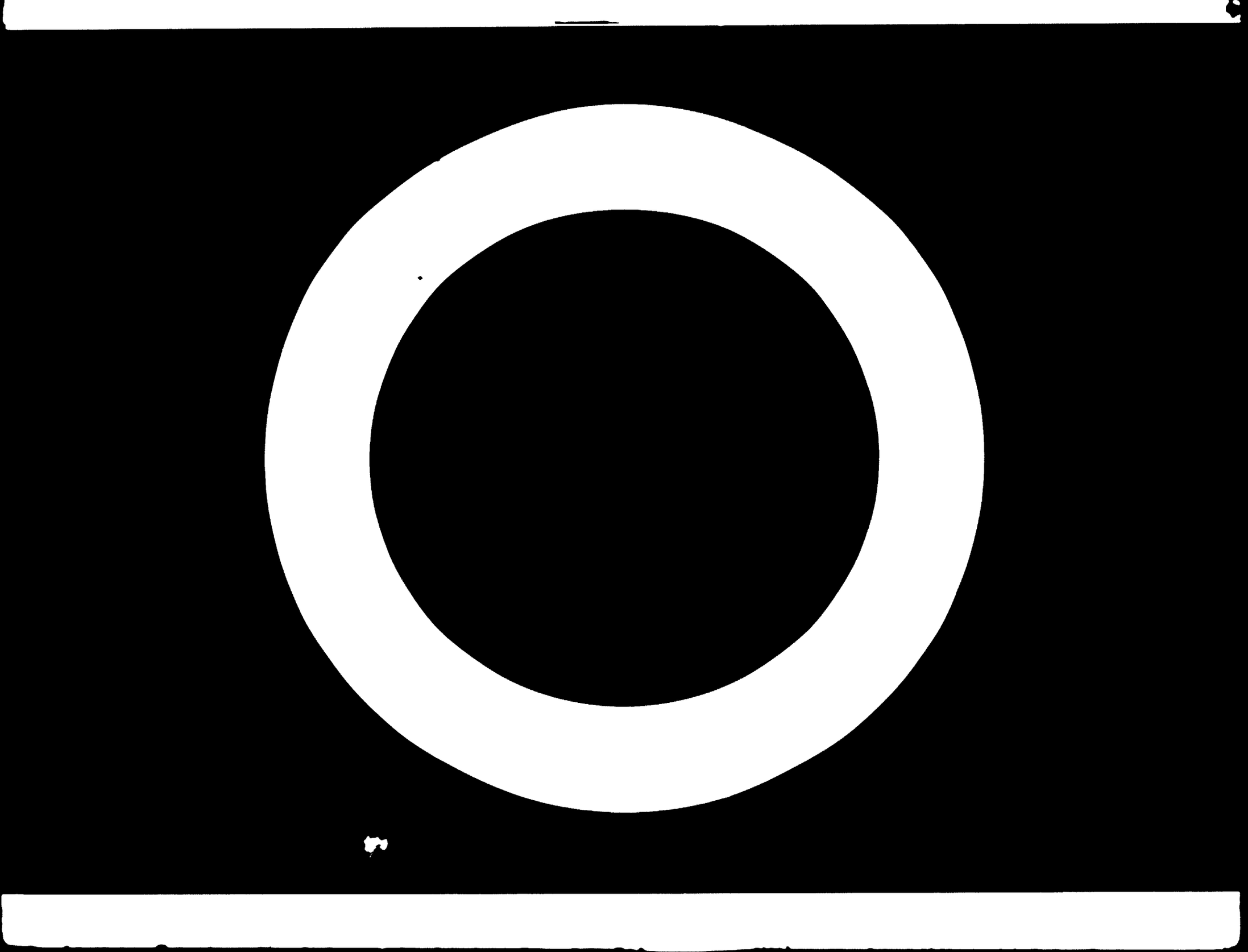
6/ ESCAP Programme of Work and Priorities 1975-77, specific activity 01.5(iv): Priority Project on Regional Co-operation in Chemical Fertilizer Production and Distribution. See Annex III to this paper (p.) for a final report on the project.

stages, however, including a general comparative study on fertilizer marketing and distribution in the ESCAP region. This is being conducted as part of the Asian Agricultural Requisites Scheme funded by the Netherlands Government, by a team working in the Joint ESCAP/FAO Agriculture Division.

55. Three new fertilizer projects involving ESCAP are beginning in 1976, in spite of severe shortages of UNDP funds at the present time. These comprise a joint FAO/ESCAP study on the use of organic manures, already commenced; an ESCAP/FAO inter-country project comprising field studies and national workshops on fertilizer marketing at the small farmer level, scheduled to begin in March 1976; and a training seminar for government officials on the promotion of effective fertilizer use in food production by small farmers.

56. Projects such as these represent activity on a regional basis to combat food shortages in developing ESCAP countries, and demonstrate the attention being paid to the demand side of the problem, and to some extent to the supply side. Other international activities summarized in this chapter have been concerned largely with the channelling of emergency aid and technical assistance from developed to developing countries. As we have seen, even in an emergency situation international efforts have mobilized only limited support, and they cannot readily contain the detailed consideration of problems and opportunities necessary to deal with a complex, product- and feedstock-differentiated industry like chemical fertilizer. It is clear that greater efforts by donor countries and international agencies need to be complemented by more self-reliant national, subregional and regional approaches in order to lay the basis for long-term remedies for existing and potential food shortages.

/Chapter 3:



Chapter 5: Demand Conditions

Underlying factors

57. The accurate projection of future domestic demand for chemical fertilizers is as important as it is difficult. This chapter dwells on the latter quality, since the former is self-evident and anyway illustrated by the discussion on the costs of unplanned imbalances, in Part C of this paper. After describing some of the factors which make estimation difficult, the chapter draws attention to the variety of estimates made by different analysts and then sets out some alternative demand scenarios arising from different sets of assumptions. These indicate the very considerable margins of error which may occur without more sophisticated research than that presently available. If such errors are compounded rather than offset by over- or under-achievement of production targets, the unexpected surpluses or shortages may cause severe embarrassment to developing ESCAP countries.

58. Several factors underlie the anticipated large increase in demand for Asian-produced fertilizers. In the first place, Asian demand for chemical fertilizers from whatever source will expand manifold over the next two decades for two basic reasons: high population growth rates over this period will produce increasing demands for food, even at existing *per capita* consumption levels; and government policies are increasingly concerned not only with supplying more food to meet population growth but also with increasing and securing *per capita* food consumption above these, often subsistence, levels.

59. In the second place, food security, especially in view of declining growth of food production and reduced aid propensity on the part of developed countries, requires that a very large proportion of Asian food consumption is produced domestically, or at least within the region. So the output of Asian farms must rise. Fortunately, the potential output of much Asian cultivable land is well above present levels, even in the present state of technology and relative prices. The expanded application of modern technology and improved resource allocation -- and *a fortiori* further technological advances and price changes to meet the greater food need -- will produce a wide range of innovations, particularly the increased use of high-yielding cereal varieties. High-yielding varieties, even on a crop basis, require the use of greater quantities of fertilizer both absolutely and relative to organic manures; moreover they facilitate multiple cropping, further expanding total chemical fertilizer requirements.

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60. Fertilizer application in terms of kilograms of NPK per hectare of arable land in most Asian and Pacific countries is now rather low by international standards, as table 1 shows. Asian consumption of all nutrients was about 15 kg/ha of agricultural land in 1973/74, representing about 7 kg per capita. These figures may be contrasted with 124 kg/ha and 61 kg/head for Europe. For N alone, the average consumption on Asian agricultural land was little more than 9 kg/ha in 1973/74, and this included over 120 kg/ha for Japan and Korea, but only about 11 kg for Bangladesh, China, India, Indonesia, etc. However, the expected consumption in 1985 for India and Indonesia is 30 kg and 38 kg respectively, reflecting the increased food production which these, like most other Asian countries, hope to attain. Indeed, fertilizer application will have to increase considerably if per hectare productivity of food and agricultural commodities is to be raised near target levels.

61. Greater national efforts can already be observed in many developing ESCAP countries in expanding irrigation to enable the planting of high yielding varieties and in providing improved infrastructures such as roads, transport, storage, electricity and extension work coupled with the supply of agricultural credit to small farmers. All of these activities are conducive to greater fertilizer application on farmland, sometimes by raising the return from it, sometimes by relaxing institutional constraints upon it. Since the world-wide need to produce more food is expected to become increasingly urgent during the period up to 1979/80 and thereafter, the need for increased application of fertilizers per hectare in the developing ESCAP region is further enhanced. Thus government policies will have to emphasize more than ever the easier access of all farmers to essential inputs such as fertilizers; and much of this growth needs to occur quickly in order to make up for the slow-down which has occurred in many ESCAP countries in the previous and present fertilizer years.

62. Two sets of reasons may be cited for optimism that such demand growth will in fact occur. In the first place, a key determinant of the consumption level is price. This may be included in the scope of government policy and it would be the critical factor in the absence of government intervention. Prices for agricultural produce have been fluctuating widely in most developing ESCAP countries, and although the ratio between the value of the yield increased by fertilizer and the cost of fertilizer (VCR) has probably remained positive in most cases, it has become less favourable for a number of crops in recent months.

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These relative price trends have helped bring about slower growth or even reductions in fertilizer use over the past two years. In the medium term however, relative prices of food and agricultural to industrial commodities are expected to rise while fertilizer prices should be kept within reasonable bounds of fluctuation by the planned rapid increase in supply of fertilizers within developing countries. Insofar as these relative price conditions apply, the VCR will become more favourable, making it easier for Asian farmers to initiate or accept a greater application of fertilizer per hectare in many developing countries of our region. However the extent to which this will occur in various situations cannot be predicted until more information is available on the income-elasticity of demand for fertilizer.

63. A second set of factors relate to government policies to promote small-farmer food production. Although higher prices of fertilizers have affected adversely small and weaker farmers in the application of fertilizers in a number of crops (wheat, maize, barley, sorghum, etc.), several current trends should give a great impetus to increasing the use of fertilizers among them, thus increasing the total demand for fertilizers by 1979/80 and again by 1984/85. These trends include the emphasis increasingly placed on raising production by small farmers as a principal rural development strategy, as well as the declining fertilizer prices and the higher relative prices expected of food crops and agricultural export commodities produced in most developing ESCAP countries. Once small farmers gain greater purchasing power and become significant fertilizer users on Asian farms, there will be a tremendous increase in the total demand for fertilizers of all types. Supply and demand should promote each other in this market, through the further domestic production of fertilizers giving small farmers readier access to fertilizers at reasonable prices. However the subsidy programmes in some developing ESCAP countries may have to be strengthened to complement more fundamental measures to enhance the use of fertilizers among small farmers.

64. This expected growth in demand for fertilizer on Asian farms is being translated into demand for the output of Asian fertilizer factories by several economic and strategic considerations. These include high freight costs, the increasing availability of Asian raw materials and hydrocarbon feedstocks, the desire of developed countries' governments and firms to de-emphasize their fertilizer production, and developing countries' lack of confidence in the smooth flow of imports. They reduce the availability or attractiveness of

/non-Asian

non-Asian supplies, especially over the long term when existing low-cost production facilities in the US, Japan and Europe may be phased out. To some extent the ready availability, and sometimes low opportunity cost, of feedstocks discovered in several Asian countries will offset the higher investment costs of establishing domestic fertilizer facilities in developing countries which must import plant and machinery. But even if local production is not competitive, the need for food security will continue to be satisfied through at least partial self-sufficiency in fertilizers, at least as long as governments in developing ESCAP countries fear severe fluctuations in world prices or availabilities.

65. If it could be assumed that plentiful world supplies of the appropriate products would be available at reasonably steady prices each year, the strategic would be less important than the cost-related considerations. In this situation governments' decisions on whether, how much and what to produce domestically would be relatively straight-forward. Import or alternate-use costs of feedstocks, opportunity costs of capital investment, attainable efficiency levels, and the scale economies permitted by domestic and perhaps export markets would dictate local production costs which could be compared with anticipated c.i.f. prices for imported products. Even in this situation, considerable fertilizer production would occur in the developing ESCAP region, but probably only at those locations where cheap natural gas and transport savings would offset developing countries' higher investment and production costs.

66. In practice, however, the situation is complicated by absence of confidence in the world fertilizer market, wrought mainly by the combined food/fertilizer/energy crisis of 1973/74. This has intensified the desire of developing ESCAP countries, especially those with severe balance-of-payments constraints, to add fertilizer manufacture to their sets of import-substitution industries. While such decisions would have been taken in some countries (such as Iran and Indonesia) anyway, based more or less on considerations of comparative advantage mainly characterized by natural gas availability, plans for domestic production in other countries (such as India) may have been motivated more by a desire for secure supplies than by an economic selection of appropriate fields for import-substitution.

67. In this situation fertilizer targets are being couched increasingly in terms of the proportion of demand to be satisfied by domestic production - an approach more appropriate to a political or journalistic summary of the results

of an industrialization policy than to a planning exercise. Thus one learns that the Philippines would like to achieve [illegible] per cent self-sufficiency, or that India should produce [illegible] per cent of its fertilizer needs in order to avert mass starvation if the flow of imports were to [illegible] or become prohibitively expensive. Since some fertilizer products clearly cannot be produced domestically at all due to the lack of inputs, such proportions of total needs imply even higher percentages for other products such as urea. Part B of this paper indicates some of the reasons why such national targets may be attained through domestic production whose inefficiency causes a higher price than intended to be paid by the farmer, taxpayer or consumer for the apparent luxury of secure supply.

Problems of estimation

68. Apart from this problem of high-cost production in some cases, the developments outlined in this chapter are welcome since they will undoubtedly bring demand closer to requirements in the case of fertilizer, and production closer to targets in the case of food. However some serious problems will inhibit the accurate projection of fertilizer consumption levels. First, the very magnitude of the expansion programme means that even small errors in the assumed rate of growth each year, compounded over the several years between initiation and completion of new facilities, would produce very large differences in absolute terms. This is especially true of large countries such as India, where an annual growth rate of (say) 11.2 per cent on a 1973/74 base of 3 million tons N would yield a 1983/84 consumption projection more than 6.2 million tons N higher than that resulting from a rate of 10.7 per cent. This difference is equivalent to about the entire output of one full-sized ammonia/urea complex. Over a further five years it would account for that of three more such plants, involving a total of well over $600 million in investment costs (even at estimated 1973 prices). The different growth rates adopted in two recent projection exercises are compared in table 11 .

69. Second, while general price trends can be anticipated to some extent, the actual prices which will apply in each year are very difficult to forsee. Even if this was not the case, the present lack of knowledge of price elasticity would prevent accurate estimates of the demand levels which would be derived from the price pattern. The rise in price which occurred in 1973/74 appears to have caused consumption levels to fall by as much as 25 per cent in some parts of the region, but almost no precise information on price elasticity is yet available

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Third, while governments are surely aiming their policies at greater fertilizer use, it remains very difficult for even them to predict the extent to which appropriate measures to stimulate effective demand will be coherently formulated and successfully implemented. Achievement seldom mirrors intent in precise terms in the development process, especially in areas such as this where a variety of policy instruments must be involved and where success in one respect (fertilizer consumption) depends on that in others (irrigation, extension work, pricing policy etc.) which are themselves affected by complex government programmes involving institutional reorganization.

70. A fourth type of difficulty results from the inadequacy of existing data on recent consumption levels, which must be known before growth rates applied to them can yield future levels. Unfortunately the recent crisis has been accompanied by speculative trading, causing incidents of re-exporting, undeclared sales and unaccounted stocks to abound in the region, and thereby precluding accurate estimates even for past years. As table 11 indicates, projection exercises carried out in the region in 1975 used estimates for 1973/74 consumption which differed by over 500,000 tons N in the case of India, 60,000 tons for Pakistan, and around 40 to 50,000 tons for each of Indonesia, Iran, Malaysia and Bangladesh. More recent exercises by other investigators whose work is not yet published suggest that even fairly conservative estimates of recent consumption levels in some ESCAP countries may be too high.

71. For these reasons, projections of the derived demand for fertilizer will remain uncertain - although hopefully less so that at present. It is evident that much more reliable estimates are necessary before resources should be committed to investment in production facilities which will raise output above minimum expected demand levels. Therefore the pooling of the technical expertise and experience of various developing countries is desirable in order to make demand projections as sophisticated and accurate

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as possible from the point of view of each country individually. Technical assistance from outside the region also should prove helpful in this activity, which should include exercises to determine the responsiveness of demand to price changes.

72. Furthermore, since neighbouring countries may be significant potential markets for both planned and unplanned surpluses of each producing country, it is clearly desirable for accurate information on anticipated shortages and surpluses to be produced and exchanged among countries, so that each can take subregional export markets into account in its own planning. This information should assist the short-term disposal of unexpected or unavoidable surpluses as well as the advance planning of new investment, and the selection of products and processes as well as total levels of output from national facilities.

73. A rather different but equally important implication of the problem of uncertainty in estimating future demand is that domestic supply programmes should be designed in such a way that they are as flexible as possible. The pattern of expenditures by which production can be expanded should be programmed so that modifications in plant planning construction activities and alternative imports can be made as improved demand forecasts appear. Moreover the programmes should be able to accommodate quite different domestic demand levels than those on the basis of which they were formulated - for example by taking domestic demand of several countries into account in each national fertilizer programme. To the extent that shortfalls and surpluses due to changes in both demand and supply levels should offset each other to a greater extent in a large market than a smaller, the necessary flexibility may have to be achieved through close regional or subregional co-operation. Since an important element of the uncertainty about demand derives from external developments which need to be reported and analysed, intergovernmental efforts on this front should reduce the uncertainty to a more acceptable level, even in the absence of intercountry economic co-operation.

/Possible

Possible demand levels

74. Urgent work to derive more precise demand projections for Asian countries is clearly necessary. But in the meantime some consumption assumptions must be used to permit the illustration of possible implications for regional trade and co-operation of various supply considerations. For this purposes in Part C of the present paper, mean estimates have been calculated on the basis of various demand projections made for each of 11 developing ESCAP countries by official agencies and international analysts over the past few months. These estimates and projections, compared in Tables 11 and 12, include those of:

(i) the Expert Group Meeting on Chemical Fertilizer Production and distribution convened at ESCAP in June 1975; this used FAO base figures for 1973/74 and revised or endorsed 1979/80, 1984/85 and 1989/90 projections made by:

(ii) the UNIDO/ESCAP Priority Project missions to the 11 countries in April/May 1975; these missions collected official planning estimates where available, in some cases amending them in the light of other considerations;

(iii) a subsequent exercise undertaken in October 1975 by one of the Expert Group members, calculating 1979/80, 1984/85 and 1989/90 levels by least squares analysis on the basis for best straight lines for consumption between 1963 and 1974;

(iv) the "high", "mid-point" and "low" estimates for 1973/74 and 1979/80 adopted by the TVA's International Fertilizer Development Centre in its June 1975 Appraisal of the Fertilizer Market and Trends in Asia; the Appraisal project felt that the multiplicity of factors affecting demand make the use of high/low ranges more helpful than single-figure estimates.

As well, Table 12 includes for each country the arithmetic means of the highest and lowest among these sets of projections for 1979/80, 1984/85 and 1989/90.

75. Before considering these mean demand projections, it is useful to compare the various sets of estimates. First, as noted above, there is even considerable disagreement about current or recent consumption levels. The TVA/IFDC mid-point estimates for 1973/74 are higher than the FAO statistics in the cases of India, Pakistan and Sri Lanka, by a combined total of almost 0.4 million tons N, while for the other eight countries they are lower. For

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the 11 countries as a whole, the FAO statistics (which have been adopted as base levels by the UNIDO/ESCAP Expert Group) total about 0.2 million tons N less than the TVA/IFDC mid-point estimates, and even slightly below its total of low estimate. Information collected during UNIDO/ESCAP project missions supported the TVA/IFDC mid-point figures in some cases but the FAO statistics in others.

76. For the 1974/75 fertilizer year the project missions' estimates were above the mid-point estimates of the TVA/IFDC for Iran, Indonesia, Bangladesh, Sri Lanka, Afghanistan and (at first count) the Republic of Korea and the Philippines, but 0.2 million tons N lower in the case of India. These differences tended to balance out, so that the revised project mission total for the 11 countries was only slightly above the comparable TVA/IFDC total of 4.3 million tons N. However some analysts who have examined both official and trade sources in some of the 11 countries have indicated that the above estimates may be too high, suggesting that their combined total may not have exceeded 4 million tons.

77. Second, quite different growth rates over the next half-decade have been assumed by the TVA/IFDC exercise and the Expert Group in several cases. The UNIDO/ESCAP Experts anticipated more rapid growth overall (11.5 per cent per annum compared with just over 10 per cent assumed by the TVA/IFDC), in spite of less rapid growth in Bangladesh, Malaysia and the Republic of Korea. The Experts expect growth rates above 12 per cent in Iran, the Philippines, Pakistan and Sri Lanka, and rates around 11-12 per cent in India and Indonesia. The various anticipated growth rates are shown in Table 11 along with the estimated 1973/74 and 1974/75 based levels referred to above.

78. The combined effects of the estimated 1973/74 or 1974/75 base levels and the anticipated rates of growth over the ensuing half-decade result in differences in the 1979/80 projections which are greater in some cases but smaller in others. The Expert Group expected higher consumption levels than the TVA/IFDC nine of the countries, but lower levels for India and the Republic of Korea. The nine countries are expected to consume 2.9 million tons N by the Expert Group, but less than 2.4 million tons N by the TVA/IFDC, while the comparable projections for India are 3.6 and 3.9 million tons N and those for the Republic of Korea are 0.5 and 0.6 million tons N. These differences produce an overall difference of only 144,000 tons N for the 11 countries together, as Table 12 shows.

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79. The more recent least-squares exercise conducted by a member of the Expert Group has produced lower 1979/80 projections for seven of the countries, significantly so in the cases of Indonesia, Iran, the Philippines and the Republic of Korea. The estimates derived on this basis total 6.2 million tons N for the 11 countries as a whole, compared with 7.4, 7.0, 6.9 and 6.3 million tons N for the high TVA/IFDC, Expert Group, mid-point TVA/IFDC and low TVA/IFDC projections respectively. It would appear therefore that production plans aimed at self-sufficiency could result in a large regional surplus in 1979/80 if effective demand projections prove to be optimistic, whether because they were based on exaggerated present consumption levels or because over-ambitious growth rates were assumed.

80. In the absence of better information, arithmetic means have been calculated for the purposes of considering possible supply-demand balances later in the present paper. Admittedly arbitrary, these are taken as the mid-points between the highest and lowest of the five projections mentioned above for 1979/80, and between the Expert Group and least-squares exercise projections for 1984/85 and 1989/90. As Table 12 shows, total consumption for 1979/80 would still be about 6.8 million tons N, of which 3.7 million tons N would be attributable to India and 1.1 million tons N to the ASEAN countries together.

81. The continuing expansion of consumption during the following decade produces Expert Group projections of 11 million tons N for the 1984/85 fertilizer year and almost 17 million tons N for 1989/90. However, the least-squares exercise suggests lower levels of 9 million tons N in 1984/85 and less than 12.5 million tons N at the end of the decade. The difference between the two projections for 1989/90 amounts to 4.6 million tons N, and the arithmetic mean would be about 14.7 million tons N. Of this, India would account for 9.1 million tons N, ASEAN for 2.1 million tons N and Pakistan for over 1.5 million tons N.

82. The demand for phosphatic fertilizers for the same group of 11 countries is shown in Table 13, using only the Expert Group's estimates although modifications would probably be suggested if recent projections using the least-squares technique were incorporated as they were in the case of nitrogenous fertilizer. Total consumption of the 11 countries is expected to more than double from 1.3 million tons P_2O_5 in 1973/74 to 2.7 million tons by the end of this decade, and to continue to expand strongly through the eighties, reaching 4.2 million tons in the middle and 6.6 million tons in 1989/90. India accounts for the largest share of demand, needing 3.8 million tons by the end of the next decade, when the combined ASEAN consumption may reach 1.2 million tons.

/PART B:

PART B: SUPPLY CONDITIONS AND CONSTRAINTS

Chapter 4. Present and Planned Production

Existing Facilities

83. Almost all ESCAP developing countries with significant fertilizer use produce chemical fertilizer, although in some cases the domestic plants mainly process imported product or are small units supplying insignificant proportions of domestic demand. Table 14 records 1973/74 or calendar 1974 nitrogen and phosphate fertilizer production capacities, output levels, utilization rates and approximate proportions of the market for the 10 presently-producing countries studied in the UNIDO/ESCAP priority project. (Sri Lanka, like Singapore has no existing industry.) The combined installed capacity of Afghanistan, Bangladesh, India, Indonesia, Iran, the Republic of Korea, Malaysia, Pakistan, the Philippines and Thailand amounted to approximately 3.4 million tons N and slightly more than 1 million tons of P_2O_5 by the beginning of 1975. India alone accounted for around 55 per cent of the capacity in nitrogen and 45 per cent of the capacity in phosphates. With a few exceptions, the existing installations are all within a daily capacity range of 150 to 500 tons of ammonia or 30 to 120 tons of P_2O_5. This is much smaller than the optimum-size modern plant, especially in the case of nitrogen for which plants producing 1000 tons/day ammonia and 1667 tons/day urea with nutrient content of 767 tons N are becoming the norm.

84. Collectively, the group produced 2.3 million tons N and 0.6 million tons P_2O_5 from its installed capacity in the 1973/74 fertilizer year. Indian plants produced more than 1 million tons of the N, the only other significant producers being the Republic of Korea and Pakistan. Moderate increases in India, Indonesia and the Republic of Korea, only partly offset by a fall in production in Bangladesh, made combined output of nitrogen in the 1974 calendar year slightly higher at 2.4 million tons N. All four significant phosphate producing countries, India, the Republic of Korea, Iran and the Philippines, raised output in calendar 1974, but only by a few thousand tons of nutrient each.

85. Four countries, Afghanistan, Bangladesh, India and the Republic of Korea, had sufficient capacities installed to meet all or nearly all of their domestic demand for nitrogenous fertilizers, but with the exception of Korea they were not able to do so because output remained significantly below designed capacity levels.

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As a whole, the group's installed capacities operated at about [illegible] per cent of design capacity for both nitrogen and phosphates, but there were wide variations between countries as table 14 shows. Afghanistan and Bangladesh did particularly badly, and poor performance in Thailand's old nitrogen facilities held the ASEAN subgroup's average utilization rate down to 50 per cent. This was in spite of good performance in Malaysia which, like Pakistan, the Republic of Korea and Iran, enjoyed rates of 90 per cent or more. The Republic of Korea utilized its phosphate capacity very well too. A reasonable rate was recorded in Iran, but India and Pakistan achieved less than 50 per cent in their phosphate plants.

86. The main reasons for low capacity utilization in many of the nitrogen plants were major equipment failures, power failures and inadequate power supply, unavailability of spares and feedstocks, and apparent weaknesses in operation management, particularly in the field of proper and timely maintenance. In the case of phosphate plants, low production was usually due to lack of imported raw materials and spares. It is noteworthy that grosso modo, the plants in the private sector operated at a respectably higher rate than those established in the public sector. The identification of various problems causing low utilization rates has led to the formulation of several recommendations for technical assistance to relieve them and improve old plants' performance where possible. This assistance, which can be found within the region through inter-country co-operation as well as acquired from more international sources, is discussed in Part D (mainly chapter 11) below.

87. Apart from low utilization rates, many existing plants face the difficulty of having been designed to use feedstocks other than the relatively efficient natural gas. Indeed only 31 per cent of the installed capacity rated at 3.9 million tons N at the beginning of 1975, is based on gas, while fully 55 per cent depends on high-cost naphtha, and smaller proportions use coal, hydro-power, refinery gas, fuel oil and other feedstocks. There is little scope for conversion of existing plants. However some of the least efficient of these will need to be phased out anyway if they are not susceptible to efforts to solve their low utilization problems. Moreover the feedstock pattern is expected to improve by the end of the present decade as new plant construction reflects relative prices of the different hydrocarbon sources. Unfortunately gas-based plants still account for less than half of the new capacity being brought on stream between 1975 and 1979, but fuel oil is becoming more important while expensive

/naphtha

naphtha represents only a fifth of the new capacity. A fuller discussion of raw materials considerations is in the following chapter 5.

88. The UNIDO/ESCAP Priority project from which this paper arises studied in detail production for only the 10 countries mentioned, plus Sri Lanka which had no production facilities by mid-decade. Several other ESCAP member countries have significant existing, intended or possible fertilizer production, however, and table 26 includes the 1973/74 output levels of Burma, China, Japan and non-ESCAP East Asia, amounting to 5.6 million tons N. Also shown is the production figure for Persian Gulf countries situated to the west of the ESCAP region; although this was only 0.5 million tons N in 1973/74, most of these countries are petroleum producers and therefore significant potential suppliers of hydrocarbon-based nitrogen. Table 27 has corresponding phosphate estimates.

New Capacities and 1979/80 Output

89. Significant efforts are at present being undertaken within the region to expand production. Projects which had remained in the pipeline for many years are now under construction or firmly committed for implementation in a massive investment programme initiated since 1973, with financial support from external sources. If current commitments were maintained, some 30 new fertilizer plants should have come on stream by 1980 in the 10 countries already discussed and Sri Lanka. These and expansion projects will add more than 5.3 million tons N plus 1.3 million tons P_2O_5 to existing capacities, raising the totals to 9.2 million tons N and over 2.3 million tons P_2O_5. These new plants and expansions are listed in Table 15. Meanwhile Table 16 quantifies estimated capacities by the beginning of 1980, and estimated nitrogen and phosphates production in the 1979/80 fertilizer year in both cases in terms of nutrient value.

90. India will account for a large part of the new capacity, although its share of the group's total installed nitrogen and phosphate capacity is expected to fall somewhat to 51 and 58 per cent respectively by 1980. Other large increases in nitrogen capacity should occur in Indonesia, Pakistan and Iran, with smaller amounts in Bangladesh, Sri Lanka, the Republic of Korea, Afghanistan and the Philippines. With respect to phosphates, large expansion of capacity should occur in the existing production countries (except the Republic of Korea), while Bangladesh and Sri Lanka will have entered the industry. The size of most the new nitrogen units in the region will be around 1,000 tons/day ammonia, 1,667 tons/day urea (i.e. about 250,000 tons/year N), while most new phosphate plants

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will have daily capacities ranging from 100 to 700 tons P_2O_5. With a few exceptions, all new nitrogen and phosphate units will apply up-to-date process technologies and will have their own captive sources of energy.

91. Fertilizer production levels in 1979/80 are estimated in the table to total 7.4 million tons N and 1.7 million tons P_2O_5 for the 11 countries, i.e. three times 1973/74 levels. This assumes operating rates of 85 per cent or 90 per cent for each country except Thailand in the case of nitrogen. As noted earlier, some countries in the region already have experienced operating rates of 90 per cent or more in recent years, and others, including India, are assumed to be able to attain an average operating rate of 80 per cent by the end of the decade. Although their existing facilities have been operating at much lower rates, it is expected that Afghanistan, Bangladesh and the Philippines, as well as India, should be able to attain at least this rate through good management and effective training programmes. For phosphates, operating levels of 90 per cent in the Republic of Korea and 75 per cent in other producing countries are assumed. Among Asian countries outside the group examined here, significant production increases are expected to occur in China (5.6 compared with 3.2 million tons N, and 1.5 compared with 1.0 million tons P_2O_5), other East Asian countries outside ESCAP (0.8 compared with 0.49 million tons N), and the Persian Gulf.

92. Whether the estimates of both capacity and production given in Table 16 will be actually attained in 1979/80 depends on many factors, including four positive factors, viz:

(i) Some additional new plants, not included in Table 16, may be completed and come on stream by 1980, offsetting delays in other planned plants.

(ii) The new plants coming on stream between 1975 and 1980 are of more modern design and should attain higher operating rates than the average of the plants in operation in 1975, while some of them are being designed for higher production rates than the name plate capacity, i.e. built-in over-capacity.

(iii) The operating rates of the older plants may be improved during the 1975-1980 period by debottlenecking and other minor improvements.

(iv) A greater fraction of the output of ammonia and other intermediate plants in the region may go into fertilizers in 1980, and less into non-fertilizer uses than at present.

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93. On the other hand, production in 1979/80 could be lower than that assumed on account of such negative factors as:

(v) Some of the plants listed in Table 15 may suffer delays to prevent their coming on stream by 1979; there are indications that the new floating plant under construction for location off East Kalimantan may be delayed.

(vi) A few of the plants already in operation in 1979 may be phased out before 1980 and therefore would not contribute to production in 1979/80 as anticipated.

(vii) In the case of India there will be two new nitrogen plants based on coal and several new plants based on fuel oil, both of which cases involve technologies not yet fully tested and proven for the particular feedstocks available or for the size of equipment.

(viii) The operating rates assumed in Table 16 may not be attained; for example, if India should improve its average operating rate only to 70 per cent instead of 80 per cent, India and thereby regional production would be almost half a million tons less than indicated.

Further capacity in the 1980s

94. Fertilizer capacity which may be put in place during the 'eighties is not yet formally committed, although many plants not yet contracted or under construction are already in the final planning stage. Moreover a large number of additional plants not yet announced or even planned will undoubtedly be planned, contracted and built by the middle of the decade, with still further facilities to be put in place by 1990. Indeed, new projects in Bangladesh, India, Indonesia and the Philippines, amounting to over 3 million tons N, have already reached the final planning stage but probably will not be implemented until the 1980-1985 period due to financing constraints. Furthermore recent gas discoveries and fears of future shortages endangering food production have caused several large plants in such countries as Thailand and Malaysia, and also in Brunei, Burma and perhaps Singapore to have been mooted or announced since the list in Table 16 was compiled in mid-1975. In some of these cases, which together represent a further 1 million tons N, rapid implementation is intended.

95. The amount of such additional capacity would be very large indeed - perhaps 20 million tons N and P_2O_5 together - if governments maintained present intentions, including their objectives with respect to the proportion of domestic

/requirements

requirements to be met by local production. The investment cost alone of the capacity to be installed in the countries mentioned during 'eighties could amount to as much as $15 billion without allowing for inflation; and national surpluses if this capacity were fully utilized while consumption levels proved resistent to efforts to expand them rapidly could total as much as 10 million tons N a year. This issue is taken up in the discussion supply/demand balances in Part C (mainly chapter 7) below. Meanwhile, however, some of the raw materials endowment and economic considerations which should influence such investment decisions are discussed in the rest of the present Part B.

/Chapter 5:

Chapter 5. Raw Materials

Fertilizer Requirements

96. The three main fertilizer nutrients, nitrogen (N), phosphorous pentoxide (P_2O_5) and potassium oxide (K_2O) require different raw materials for the manufacture of the various products containing them. N is usually applied in the form of urea, ammonium nitrate or ammonium sulphate, all of which are compounds of ammonia (NH_3) derived from atmospheric nitrogen and one of several hydrocarbon feedstocks. The most efficient of these, if it is available, is natural gas but alternative sources of hydrogen for the ammonia synthesis are naphtha, heavy fuel oils, coal or lignite, oil refinery tail gas and hydro-electric power.

97. Table 17 illustrates the increasing role of gas in the new capacity being installed in 1975-79 in the 11 ESCAP countries under consideration, and also its more moderate role in the longer term as a result fuel oil being the dominant feedstock for the facilities likely to be put in place in 1980-85. In 10 years' time the present composition of 55 per cent naphtha, 31 per cent gas, 6 per cent coal and 1 per cent fuel oil will have become 39 per cent gas, about 25 per cent each naphtha and fuel oil, and 7 per cent coal.

98. P_2O_5 is applied mainly in the form of the compound diammonium phosphate (DAP) or as single or triple superphosphate (SSP or TSP). These products are based primarily on wet-process phosphoric acid which is derived from rock phosphate and sulphuric acid (H_2SO_4). The latter may be produced from any of: sulphide ores (pyrites); elemental sulphur which is mined as such by the Frasch process or recovered from (sour) natural gas, oil or coal, or by-product acid from smelter operations. Industries which produce by-product sulphur include copper, steel and petrochemicals.

99. K_2O, which is usually applied as a potassium salt, the most popular being KCl, is derived from carnallite or sylvite ores, often found in association with various rock salts.

Nitrogen Feedstock Endowments

100. Countries in the ESCAP and adjacent regions which have found natural gas in sufficient quantities to consider its use for ammonia and fertilizer manufacture include: Afghanistan, Australia, Bangladesh, Brunei, Burma, the People's Republic of China, Indonesia, Iran, Malaysia, New Zealand, Pakistan

/and

and Thailand, and several oil-rich neighbours in the Middle East. On the other hand, Cambodia, the two Koreas, Laos, Mongolia, Nepal, the Philippines, Singapore, Sri Lanka and the two Viet-Nams (so far at least) do not have gas, while in India and Japan quantities available are not nearly sufficient to meet their needs. All of the countries with gas, except Australia and New Zealand, have commenced or at least considered its exploitation for fertilizer purposes.

101. The TVA/IFDC Appraisal includes a calculation of the number of 1,000 ton/day ammonia plants which could be based on 25 per cent of known natural gas reserves over a 20-year period. This includes 25 for Iran, 23 for China, 15 for Indonesia, 10 for Pakistan, almost 6 for Bangladesh, almost 5 for Afghanistan, 2 for India, and less than one each for Burma and Malaysia, while the Japanese reserves would be exhausted within 20 years.[1/] Some of these estimates would need to be increased in the light of recent further gas finds, which also would add Brunei, Thailand, Australia and New Zealand to the list. Indeed, Burma, Malaysia, Brunei and Thailand now appear to be considering at least one new gas-based plant each. The TVA/IFDC exercise included also nine Middle East countries which together could support 138 plants on the same basis. It also noted that the countries cited could differ in the extent to which they have competing uses for their gas.

102. A review of the gas feedstock situations and announced intentions suggests that expanded nitrogenous fertilizer industries in several Persian Gulf countries, Iran, Afghanistan, Pakistan, Bangladesh, Burma, Thailand, Malaysia, Indonesia, Brunei and China could be based largely on indigenous natural gas by the early 1990s. Due to the limited reserves of their gas, or to the small size of their domestic markets for nitrogenous fertilizer derived from it, some of these will need to export domestic surpluses of ammonia or urea, while others (along with Australia) may be able to export LNG instead of or as well as using the gas themselves. Production facilities in these countries will not necessarily produce competitive products, despite of their gas availability, however. This will depend partly on the alternate-use value of their gas, and partly on diseconomies stemming from factors other than feedstock choice which are considered in the following chapter 6.

/103.

1/ TVA/IFDC *op. cit.* (Appraisal), p. 54, table 22.

103. Since Iran and the Persian Gulf area have enough gas to produce more than twice total world consumption of nitrogenous fertilizers, their investment plans are clearly of interest to all consuming countries and to rival producers who do not share the advantage of cheap local gas. Azerbaijan's surplus product may be directed towards the USSR rather than its ESCAP neighbours, but Bangladesh, Pakistan and Burma are potential fertilizer exporters if the low opportunity cost of their gas and social considerations encourage them to turn it into fertilizers in excess of domestic needs. Southeast Asia's hydrocarbon feedstock endowment includes plentiful gas in Indonesia only part of which already being exploited, recent discoveries in Malaysia and Thailand giving rise to hopes of domestic production, and a second discovery in Brunei which, unlike the first find, is not yet committed to alternative uses. Finally, China has more than adequate natural gas to attain self-sufficiency through the many new plants expected to be on-stream by the end of this decade.

104. Meanwhile four parts of the region with either no indigenous gas reserves or not nearly enough to serve their domestic needs are: (i) India and Sri Lanka, (ii) the Republic of Korea and Japan, (iii) the Philippines and Singapore within ASEAN, and (iv) the new Mekong states. The first two of these subgroups have expanding nitrogenous fertilizer industries based on other hydrocarbon sources, including imported LNG or naphtha, fuel oil or tail gas refined locally from imported crude, or indigenous coal. The third subgroup countries may proceed with production based on imported hydrocarbons or refinery by-products, while the last subgroup countries have discovered no exploitable gas or other efficient hydrocarbons at this stage.

105. India's large existing industry uses several feedstocks, mainly naphtha, but the most notable development of the near future will be the commissioning of two large modern plants based on coal. The large South Asian consuming country has attempted to participate in the exploitation of Bangladesh gas, and further steps could be taken to secure supplies of LNG, ammonia or fertilizer from other gas-owning neighbours such as Iran, Pakistan and Burma. Interestingly, India will be a committed buyer of fertilizer from Sri Lanka's new plant to be based on naphtha derived from imported crude. Once fixed costs for this plant are committed, it will supply Sri Lanka's own needs as well even if the higher cost of naphtha would have made imported gas-based supplies a more economical proposition. However, India will remain interested in further expansion of capacity or secured supplies, and will need to assess carefully the costs of its various options with respect to feedstocks.

/106.

106. Japan and the Republic of Korea have heavily industrialized, although the former is being held at existing capacity while the latter continues to expand. Japan's industry is based on several feedstocks, which might include LNG from Brunei, Iran, Australia, Malaysia, Pakistan and Indonesia. The c.i.f. price for the Brunei gas is about 50 cents/1,000 ft³, while the price for supplies from the newer fields may well be around 70 cents, mainly to increase the liquefaction costs. Japan's high demand for gasoline means naphtha is good fuel more expensive, and some of the naphtha-based plants rendered uneconomic by high oil prices could be phased out over the next few years, especially since most of Japan's output must be exported. The Republic of Korea has achieved self-sufficiency on the basis of naphtha or fuel from imported petroleum, and additions to capacity now planned will yield a substantial export surplus in the early 1980s. However, this country also may need to seek cheaper feedstock sources, such as LNG, if further expansion is contemplated. Taken together the non-centrally planned economies of East Asia are expected to remain importers of feedstock for their healthy industries.

107. A detailed study on the expansion of the Philippines fertilizer industry was made by TVA/IFDC in 1974.[2/] Several alternative approaches for meeting the fertilizer deficit were analysed, the country's lack of feedstocks being a major consideration. This would dictate either: production abroad, perhaps in Indonesia or Brunei, in a joint-venture with the gas producer; domestic production based on imported fuel oil; or domestic production based on imported LNG, perhaps from Brunei, Indonesia, Malaysia or even Australia. The study rejected a fourth approach consisting of small plants based on expensive naphtha or refinery gas. It also considered that LNG might be preferred over fuel oil, provided that supplies from Southeast Asian producers were not all committed for sale to Japan, and that a large enough requirement could be generated, with the help of other industries, to justify the costs of shipping and storage. However, on the TVA/IFDC calculations, urea produced even in a fairly large plant in the Philippines would cost about 75 per cent more than the landed cost of imports from a large Indonesian plant, while the product from a small plant would cost three times as much. The former differential illustrates the cost of producing away from feedstock sources, while the latter incorporates also the scale element (discussed in more detail in the following chapter). Meanwhile Singapore, a substantial refiner of crude oil, may consider the production of ammonia and urea based on available naphtha.

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2/ TVA/IFDC: Expansion of the Fertilizer Industry in the Philippines, prepared for USAID, Muscle Shoals, May 1974. Further studies have been made in the Philippines in 1975, and a decision to go ahead with production based on heavy oil could be imminent.

Phosphate requirements

108. By 1980 Asia's annual phosphatic fertilizer consumption is expected to exceed 5 million tons P_2O_5, requiring for Asia production about 14 million tons of rock.3/ Present producers of rock within the region are Nauru, Christmas and (temporarily) Ocean Islands, India, China, the Democratic People's Republic of Korea and the Democratic Republic of Viet-Nam. In the rest of the region, Jordan, Syria and Israel have small, and Australia and New Zealand deposits should yield about 5 million tons a year. Combined output in 1972 is estimated to be 1.1 million tons in the ESCAP region, plus 1.5 million tons in West Asia and 1.5 in North Korea and North Viet-Nam, total 4.1 million tons. In addition, large ore reserves are estimated in Mongolia, modest amounts in Iran, Sri Lanka, Pakistan, the Philippines and the Paracels4/, and small quantities in Cambodia, Malaysia, Indonesia and Japan.3/ However, some of these deposits, like those of India, may present considerable problems of beneficiation and will not remove the need for raw material imports from more economic sources.

109. Collectively the 11 ESCAP developing countries under principal consideration in this study lack sufficient quantities of rock phosphate to satisfy the long-term needs of their industries. India will most probably manage to meet more than one-third of its requirements from its own resources and so perhaps might Iran. It is also likely that Sri Lanka, Pakistan and Afghanistan will have adequate supplies of rock phosphate to support domestic industries on a long-term basis. In the case of Sri Lanka export of rock may be possible as well, perhaps to India. However, the Republic of Korea, the Philippines, Indonesia and Bangladesh will remain dependent on foreign sources of rock supplies in the absence of sufficient deposits of commercial interest. The whole group's phosphate rock requirements by 1974/75 is expected to exceed local supplies by more than 5 million tons. To alleviate the very tight supply situation and high prices of rock in the world market, it is necessary that more concerted efforts be taken in finding new deposits and in improving beneficiation techniques for upgrading existing rock of lower grades. There is scope also for considerable supply of either rock or phosphoric acid from Australia, or perhaps of rock from the islands which presently serve Australian and New Zealand needs that may be satisfied instead by the Queensland deposits.

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3/ TVA/IFDC: op. cit. (Appraisal), p. 54; this total includes non-ESCAP countries in West Asia and North Korea and North Viet-Nam.

4/ The ownership of the Paracels is in dispute between South Viet-Nam and China.

110. There is a temporary general deficiency of sulphur in the ESCAP region and import requirements of the 11-country group are expected to total approximately 2 million tons by 1984/85. This does not include the needs of the Republic of Korea and the Philippines since their sulphuric acid needs can be derived from pyrites roasting, metallurgical and petrochemical factories. Furthermore, Iran and Pakistan also should in the future have sufficient supplies of sulphur from sour gas extraction to satisfy the long-term needs of the phosphate industry. Unfortunately gas has a low sulphur content in Pakistan, which therefore parallels Sri Lanka in having a good supply of rock but lacking sulphuric acid. India, where ore production has declined, is likely to be in a position to supply some 20 per cent of its annual requirement (1 million tons by 1984/85) in the form of sulphuric acid as a by-product from pyrites roasting. Indonesia, Malaysia and the Philippines also have access to pyrites deposits. In addition, sulphur deposits of volcanic origin occur in Indonesia and the Philippines, the reserves of the latter being about 10 million tons with a minimum of 20 per cent S, not counting a recently discovered deposit which is estimated to comprise a further 25 million tons containing 25 per cent S. As these various sources are likely to be developed, along with an expected increase in the annual output of Middle East countries to more than 2 million tons, serious constraints in supplies and prices of sulphur are not likely to occur in the region.

111. The endowments of rock and sulphur suggest several developments in the production of phosphatic fertilizers, in all cases requiring at least some trade in raw materials and in some cases implying production of phosphoric acid or phosphatic fertilizers for export as well as domestic markets. Among these is the possibility of an industry in the Philippines linked to the new copper smelter. The 1974 TVA/IFDC study recommended a plant to produce phosphoric acid for meeting domestic demand for DAP, TSP or NPK compounds.[5] Surpluses would be available for export -- perhaps exchanged for ammonia or urea -- especially if two large acid plants were to be established. Like Indonesia, Bangladesh, India, the Republic of Korea and other ammonia producers or importers which may wish to manufacture N/P_2O_5 compound fertilizers such as DAP, the Philippines would probably need to import rock to supplement its own reserves.

112. Possible sources of supply of rock (or acid) within the ESCAP region include either Australia or Nauru and Christmas Islands, and it is clear that recent developments and the investment plans of Australia need to be taken into

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5/ TVA/IFDC: op. cit. (Philippines).

account by countries interested in the future rock-phosphate and acid supply pattern. As mentioned above, another likely rock exporter is Sri Lanka (and perhaps also Pakistan) in order to help meet India's needs. Intraregional trade is also possible if China must supplement its own rock with imports from neighbouring countries to meet its huge needs. Recent unconfirmed reports suggest that some supplies from North Viet-Nam may be diverted to a new domestic US$0 million phosphatic fertilizer plant, but Japanese involvement in phosphate rock mining could place large quantities of rock on the regional market as well.

Potash Endowments

113. The area consumed 0.7 million tons of potash fertilizer (in terms of K_2O) in 1974 and demand is expected to increase to 2 million tons K_2O by 1985 and to 3.3 million by 1990. Requirements so far have been met by imports, although the recent discovery of potash deposits in Laos and Thailand appears to point to a regional solution in the medium to long-term. Tentative estimates indicate a minimum of at least 60 million tons of carnallite (90-95 per cent containing 17 per cent K_2O) in Northeast Thailand. The deposits lie on top of a vast evaporite residue of rock salt at depth varying between 100 and 150 metres in layers 30 to 50 metres thick, and are considered to be the most extensive yet found in the world. The richer sylvite (63 per cent K_2O) has also been traced in the Mekong Basin area, mainly in Vientiane on the Laos side of the River, in seams 3 metres thick in association with evaporite salt beds. There is some hope that Thailand also may have sylvite, perhaps in the area to the south of that containing the carnallite.

114. Several offers for exploitation have been submitted to the Government of Thailand but so far no mining rights have been granted. There is a vast area of ore to be prospected in detail (about 56,000 km^2) before commercial exploitation is likely to proceed, and constraints on progress are financial as well as organizational and legal. In addition, there are technical problems related to the admixture of potash with large quantities of rock salt including magnesium chloride. Existing infrastructure is not adequate to handle substantial quantities of potash salts, and international assistance may be desirable to help relieve the various constraints and promote the development of an industry which could play an important role in industrial specialization and exchange.

/115.

115. Although a potash industry in Thailand and/or Laos would present a lasting source of future supplies for the whole ESCAP region, it must be cautiously assumed that this mineral wealth will not start to play a role of commercial significance before 1985.

Value of Natural Gas

116. Natural gas is a favoured feedstock for new nitrogenous fertilizer production, for four reasons:

(i) it is plentiful in several parts of the ESCAP region and adjacent areas and, when found in association with oil, it is being flared rather than used;

(ii) it is cheap since the opportunity cost of using the reserves for fertilizers is low in those countries unprepared for the major industrialization that alternative uses require;

(iii) it is a relatively efficient source of the BTU requirement for ammonia production so that, its transport difficulty apart (and this would arise only if production close to the gas were not feasible), operating costs are lower than if (say) naphtha is used; and

(iv) the capital costs of a gas-based plant are much lower than those of one using other hydrocarbon sources, an approximate ratio of capital costs of plants built for different feedstocks being gas 100, naphtha 140, fuel oil 170, coal 200.

The relative merits of gas have been illustrated by various recent exercises comparing production costs in various types of ammonia plant.[6]

117. For countries without indigenous gas feedstock, the import of naphtha for domestic ammonia and urea production is likely to result in product which would be much more costly than that imported from new gas-based plants or existing naphtha-based plants in other countries. This higher cost would probably preclude the export of surplus fertilizer altogether (although not necessarily of the grain produced by its local application). Moreover it would represent a misallocation of resources to the extent that non-capital-related production costs including the import cost of the naphtha feedstock exceeded

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6/ TVA/IFDC: op. cit. (Appraisal); TVA/IFDC: op. cit. (Philippines); and TVA/IFDC: Proposed Development of the Phosphate and Nitrogen Fertilizer Industries in Indonesia, prepared for USAID; Muscle Shoals, December 1974.

the cost of imported urea, and that the net social return on the capital investment was exceeded by the potential return on alternative investment. From a purely foreign exchange point of view, and considering the technical lifetime of the plant, a saving might occur when the import cost of naphtha plus plant and machinery was lower than the import cost of urea. On the other hand, greater savings might be obtained from alternative investment of the considerable capital involved, provided there were export markets for the alternative output.

118. Countries with their own naphtha but no gas would be in a similar situation since the naphtha's alternative-use value is likely to be greater than its value for fertilizer production. Only if transport and related costs for importing urea and for exporting naphtha or its alternative derivatives fully compensated for the basic differential between gas and naphtha prices would naphtha-based domestic production be worthwhile. Fuel oil does not share naphtha's very high alternate-use value, and may be fairly competitive with gas if it is available domestically. However for most countries without natural gas, imported crude is necessary to derive both fuel oil and refinery tail gas.

119. For countries with gas, on the other hand, a rather different equation is involved in making the basic decision on whether to create fertilizer capacity based on the gas. In this case the issue is more simply whether it is better to:

(i) use the gas for ammonia/urea manufacture instead of for other import-saving or export-oriented industrial purposes;

(ii) use the gas for other industrial purposes and import the urea; or

(iii) liquify the gas to enable its transport as LNG for export, while importing urea and other fertilizer products, and either importing or foregoing exports of other products which the gas could help produce.

An economic choice among such options can be made on the basis of anticipated net social return. In a capital or management-scarce situation, it may pay to opt for none of the three (as some present gas-flarers do), and to allocate the scarce resources to other activity; but more likely the relative world prices of gas, ammonia, urea and other gas-based products, the relative production costs of each domestic activity, and the various transport costs involved, will dictate a solution which uses the gas resource in a sensible manner.

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120. Much may depend on the gas price of course. Without liquification and transport, the effective price is determined by the value of a fuel with which it might compete in the production of power, petro-chemicals or fertilizers. Table 18 extrapolates some recent TVA/IFDC calculations which indicate that, transport apart, gas would need to be quite expensive before it would be a less efficient feedstock than naphtha, fuel oil or coal at likely prices. While in some situations gas might have a high alternate-use value if it could replace other feedstocks for such purposes as power generation, the alternate-use value may be much lower for Asian gas whose quality or location make it unsuitable for power or liquification.

121. The transport factor may be critical in this consideration. For example, if Alaskan gas for fertilizer production and transport to Asia were priced at only 20 cents/1000 ft^3, an Indonesian competitor in the Shanghai ammonia market would need a gas cost of 36 cents or less, whereas he could easily compete with Japanese production of ammonia or urea based on imported LNG at $2.40, even if his domestic Indonesian gas price were well above 60c.[7] However, normal fluctuations of (say) 30 per cent in the price of a feedstock, once chosen, would have relatively little effect on the cost of the output. This is less true of course in the case of a feedstock such as naphtha whose high price would make it a larger proportion of operating costs, or in the case of a developed country with lower capital costs and charges.

122. Both capital and operating costs underlie the economics of alternative hydrocarbon feedstocks. An exercise calculated for the purpose of a report on a potential urea facility in the Philippines has shown that, compared with a comparable gas-based plant, facilities based on naphtha, fuel-oil or coal would incur investment costs 16 per cent, 30 per cent or 73 per cent more, respectively.[8] The main reason for this lies in the simpler steam-reforming process which gas can use, without the need for extensive purification or for synthesis gas preparation and partial oxidation.

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7/ TVA/IFDC: op. cit. (Indonesia), pp. 39-42.
8/ TVA/IFDC: op. cit. (Philippines), table 10, p. 27.

123. As for operating costs, both the running of more complex processes and the higher raw material cost per BTU make naphtha, fuel oil and coal more expensive to use than gas. The same study showed that with prices of $80/ton for fuel oil and 40c/1000 ft^3 for gas, an ammonia plant would produce output costing 60 per cent more if fuel oil were used. Four-fifths of the differential would be due to the cost of the feedstock itself, while higher capital charges and other production costs would account for the balance. In another exercise, TVA/UNIDO has shown that even at the high gas price of $2/1000 ft^3, an existing gas-based plant in a developed country would produce ammonia cheaper than its equivalent based on naphtha acquired at a conservative $90/ton. As these gas and naphtha prices are about the same price per BTU, the lower relative price of gas which is more likely to occur in practice would make it much cheaper than fuel oil per BTU delivered. At 75c/1000 ft^3 for gas and $110/ton for naphtha, for example, the gas-based plant's ammonia product cost at factory gate would be about half that of its naphtha-based equivalent, while the resulting urea product cost would be cheaper by one-third. Similar results may be obtained from comparison of gas new plants in developing countries. The gate sale price of urea in 1975 is estimated to be $185 from a plant based on gas priced at 50c/1000 ft^3, compared with $247 with naphtha costing $100/ton. Indeed, naphtha would have cost an unlikely $40/ton for the gate sales price of product derived from it to be competitive with its gas-based equivalent.

124. Inspite of these differentials, several countries in the ESCAP region are considering plants using feedstocks which are generally more expensive. Coal in India, naphtha in Sri Lanka and possibly Singapore, and perhaps heavy fuel oil or tail gas from oil refining in the Philippines are important examples of the use of feedstocks which may be economic because of their location. Careful costing of such plants is necessary, however, especially if export is necessary to support optimum output levels. This may disclose that such feedstocks do not necessarily make their product uncompetitive, provided that their transport costs and/or alternate-use values are low. Alternatively, it might occur that cheap gas in nearby countries and the high investment costs of their own facilities make the developing country's product based on less efficient feedstocks more expensive than gas-based imports, or perhaps even than local product derived from imported LNG.

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125. Such considerations are crucial elements of investment decisions; and Part D below includes several recommendations for reducing uncertainty and exploiting indigenous sources of raw materials, and for expanding trade based on comparative advantages in them through technical assistance and regional co-operation. Meanwhile the following chapter turns to other important factors affecting the cost of fertilizer production under various conditions, before the physical basis for exchange of inputs, intermediates and products and the possible nature of co-operative arrangements are explored in Part C.

/Chapter 6.

Chapter 6: Investment and Production Costs

126. Cost differentials with respect to the impact on both capital and operating costs of the choice of feedstocks have been observed above. The several other factors which affect costs, and therefore gate sales and delivered prices of fertilizer product, include:

(i) the location of the facilities in developing rather than developed countries, including the availability or cost of establishing necessary infrastructure;

(ii) the scale of operations (including the processes adopted in cases when different technologies are appropriate to plants of different sizes) and the rate of utilization of installed capacity, as well as other variations in the technology adopted, not necessarily related to scale.

(iii) relative transport costs of raw materials, intermediates and products, as a result of freight rates and the relative proximity of the different facilities to raw materials sources and product markets; and

(iv) the choice of product to act as a vehicle for the required nutrients.

Each of these factors is considered briefly in the present chapter, which also compares the combined effect on final prices of these factors, including the choice of raw materials, in some relevant illustrative cases.

Location Factors

127. The huge investment costs of establishing a modern optimum-sized ammonia/urea complex capable of producing about 262,000 tons N a year (as bagged urea) constitutes the main reason why location and other decisions need to be made with profitability in mind. Even in a developed country, such as the United States, where the plant can be fabricated and installed with local labour and equipment, it is estimated that the investment cost (including offsites and storage but not land or site preparation and location-specific costs) will reach $ 134 million for a plant opening in 1978. However, to establish such a complex in a developing country in 1978 - even without counting the additional infrastructure probably necessary there - would cost about $ 167

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million, about 25 per cent more than in the United States.[1] Whether a country foregoes other uses of its own foreign exchange, or uses borrowed capital, rising interest rates make the charges on capital investment of this magnitude very high indeed.

128. A more empirical analysis of plants already established in several Asian countries[2] has shown that investment costs per ton N of capacity have exceeded the cost for an equivalent gas/ammonia/urea plant in the United States by from 75 per cent to over 600 per cent. The highest of such cost differentials stem from some technological and scale factors which should not apply to modern plants built in the 1975-1985 period. But other reasons remain and likely delays in the supply of materials and harnessing of resources, inadequate supplies of power and transport infrastructure, lack of co-ordination between designers and constructors, etc. make the TVA/IFDC estimate of a 25 per cent differential in capital costs appear to be very conservative. It is interesting to note too that the capital cost estimate for Indonesia's current Pusri III Expansion Project, including interest during construction and escallation, is $ 192 million, including $ 158 million in foreign exchange. Compared with some other Asian countries, Indonesia has demonstrated remarkable efficiency in getting plants on-stream, but even so this plant is expected to cost about 35 per cent more than a US equivalent.

129. The figures cited above relate to plants coming on-stream about 1978. With costs rising at 10 per cent a year, a capital cost of $ 280 million for a 1983 plant can be expected. New Asian plants built at such costs must compete not only with their developed country equivalents, but also with existing American, Japanese and European facilities. Some of the latter, built as recently as 1973 and therefore still very much on-stream in 1983, were costing only about $ 47 million - one-third of the TVA/IFDC estimate for 1978, about one-quarter of the Pusri III estimate, only one-sixth of the 1983 figure suggested here. Clearly the difference in the cost of servicing the capital for these plants is very great, giving existing plants a strong competitive edge over new developing-country production facilities.

/130.

1/ TVA/IFDC: op.cit., (Appraisal), chapter 6.
2/ Johnston and Kilby: Agriculture and Structural Reform; esp. chapter 8.

130. Like original investment costs, those relating to continuing operation are usually higher in developing than developed countries. Less sophisticated and reliable infrastructure, especially the supply of power, have often caused low utilization rates, as have stoppages due to faulty design, defective equipment or lack of spare parts. Another important contribution to high running costs has been made by irregular supply of appropriate feedstocks. As well as raising production costs per unit, these problems reduce output and therefore raise the share of investment (including foreign exchange) costs which each unit must bear as well.

131. Apart from internal transport difficulties, developing country producers usually face a serious lack of the infrastructure necessary to operate fertiliser facilities efficiently. Additional costs may be imposed either by the need to establish roads, power supplies, port handling facilities, etc. especially for a new complex, or by the delays and difficulties experienced in their absence. The TVA/IFDC assumes that as well as a developing country's investment cost being about 25 per cent above that of the US battery limits plant, an allowance of a further 25 per cent needs to be made for each of auxiliary and support facilities, with more allowances for storage where applicable. In addition to all these costs, provision must be made for land and site acquisition and preparation, housing, medical and recreational facilities, port facilities, roads, the training of skilled technical and administrative labour, scientific and technical research, and the making available of fresh water and power supplies. Any of these might cause substantial cost increases at particular locations and, even if they would benefit the developing country's economy in other ways, the costs attributable to the fertilizer operat need to be taken into account. The Johnson and Kirby review of some Asian experiences has found that, in spite of a planned 40 per cent markup over US or Japanese costs to include transport, insurance and supp ary investment, many plants have incurred still additional capital expenditure, delays in completion and considerable over-runs.3/

132. Increased attention to both general and plant-specific infrastructure may be necessary to avoid such problems and reduce the cost differential due to location. Regular power supplies constitute a good example of these needs, since voltage dips, let alone full po ", can severely retard the

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3/ Johnson and Kirby, op.cit.

efficient operation of fertilizer plants. To avert this threat and secure supplies, many plants need to have [illegible] established - perhaps at a much higher cost than in an industrialized country with other users to share it. Another example, drawn from the case of Puri III, is the need to budget a fairly large sum for engineering services and project management due to Indonesia's lack of trained manpower requiring the use of expatriates on the training of local personnel.

133. Infrastructure which may affect the economics of fertilizer production concerns industry in general and chemical industries in particular. Thus there may be advantages for fertilizer facilities sited in related locations to those of other chemical industries, especially industries for which ammonia and its main derivative, nitric acid in various concentrations, is an important product or input, and those which need similar industrial services and specialized maintenance facilities. Fertilizer industries sited in such locations may benefit through both lower input costs and an available market for intermediate outputs and by-products.

Economies of Scale

134. Much of the differential in final prices of products produced in small rather than large plants is due to the choices of feedstock and process. However, some of it is due to scale alone. First, scale has a large influence on investment costs, since the cost per ton of product of establishing a 200 or 400 ton/day plant is very much higher than a 1,000 or 1,500 ton/day plant, even using the same feedstock. It has been estimated 4/ that capital investment (including auxiliary, support and storage facilities) would be almost twice as high per ton of ammonia for a 200 ton/day gas-based plant as for its 1,000 ton/day equivalent. The latter was even 20 per cent cheaper than a 600 ton plant, which, unlike its smaller counterparts, would use the same type of technology as the 1,000 ton plant i.e. steam- or gas turbine-driven centrifugal compressors. The same differentials applied to the associated urea facility. Second, scale affects operating costs since there are several cost elements which are relatively fixed regardless of plant-size.

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4/ TVA/IFDC, op.cit. (Philippines).

135. Even more critical than the scale of capacity itself may be the magnitude of the output in terms of utilization of a given capacity once established. The importance of maintaining high capacity utilization rate can be demonstrated by a comparison of only the operating costs of producing ammonia and urea (not counting interest or long-term debt or depreciation in either case, and assuming a local gas cost of $ 1/1,000 ft^3). It has been calculated[5/] that, compared with the ammonia production cost with 90 per cent utilization, the cost would rise by about 37 per cent if 60 per cent utilization were attained and by almost 100 per cent with only a 40 per cent rate. With similar variations in the utilization rate of a complementary urea plant, the resulting operating costs for ammonia and urea together would be 26 per cent higher if capacity is utilized at 60 per cent rather than 90 per cent, and 64 per cent higher if it is utilized at 40 per cent.

136. If capital charges interest and/or return on investment at 10 per cent plus depreciation are taken into account as well as operating costs, the gate sales prices at 60 and 40 per cent utilization would be raised to 40 and 100 per cent respectively above that possible with 90 per cent utilization. Apart from these capital costs, the fixed costs accounting for this difference would include labour, maintenance, taxes, insurance and overhead. Another calculation has suggested that a hypothetical 1,500 ton NH_3/day gas-based urea plant in Indonesia or Brunei could land urea in the Philippines 20 per cent cheaper than its 1,000 NH_3/day equivalent. Without the freight component, the differential would be even greater.[6/]

137. In terms of actual plants, it is interesting to note that the 1,500 ton NH_3/day East Kalimantan plants due to open in 1976 and 1978 were expected to produce urea (with 20 per cent return-on-investment) more cheaply than comparable but smaller plants. The 1,000 ton NH_3/day 1977 West Java plant, for example, using the same feedstock cost (60 , 00 ft^3) and utilization rate (80 per cent) would produce output 8 per cent dearer. Similarly, the 660 ton NH_3/day 1974 Pusri II plant is producing urea at a 35 per cent lower cost than the smaller 180 ton/day 1964 Pusri I, even though the latter's

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5/ TVA/IFDC: op.cit.(Appraisal), pp. 89-91.
6/ TVA/IFDC: op.cit.(Indonesia), p. 59, table 45.

utilization rate is taken as 134 per cent compared with 80 per cent for Pusri II and its capital charges are lower due to its age. The new 1,000 ton Pusri III plant, although using much more expensive gas (60c compared with 17c/1,000 ft^3), is expected to produce even cheaper urea.[1/]

138. Apart from differences in technology governed by the choices of scale and feedstock, there appears to be little scope for varying the process technology in modern chemical fertilizer facilities. They are necessarily capital-intensive and involve very precise chemical reactions which could be easily and expensively disturbed by attempts to depart from the standard techniques. It is well-established that modern ammonia/urea complexes cannot be operated manually: any failure of the automatic control equipment must cause a shut-down of the plant. Under some circumstances, there may be a little scope for adaptation of plant designs developed in highly industrialized countries to employ labour-extensive methods instead of full mechanization or automation. However, this may apply only to some of the phosphate, NPK compound and other downstream operations, and cannot be recommended for large-scale ammonia/urea complexes. Such possibilities should be explored however, particularly in such areas as the use of more labour in ancillary processes or the use of simpler handling and transport equipment.

Transport Costs

139. Relative transport costs are a key determinant of plant location, discussed already, but they require separate treatment as they may also affect the choice of feedstocks and of site within a country. Careful analysis is necessary of the least-cost means of transport among those which exist or can be developed for the pur[illegible]tween each pair of relevant points. Three areas in which internal and/or [illegible]national transp[illegible]onsiderations may affect investment decisions are:

(i) domestic or subregional production versus imports;
(ii) subregional versus domestic production; and
(iii) the exchange of raw materials, f[illegible]cks and intermediates.

140. The main reason why supply from domes[illegible] facilities or from a neighbouring country may have a cost advantage over purchase from (say) Alaska or [illegible]ver the Middle East or Japan would be lower sea transport cost[illegible]. Table 19 gives some illustrative international freight costs assumed for the purpose of recent calculations of production economi[illegible]. These examples suggest that transport

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1/ TVA/UNIDO: op.cit. (Indonesia), p. 54, table 45.

factors would probably give local natural gas-based production an advantage over long-distance imports from new plants in most cases. Within the region however, the freight cost is only about 10 to 15 per cent of the total, giving the domestic producer but a small margin for inferior efficiency over a neighbour also endowed with low-cost gas. Moreover, domestic production based on naphtha, fuel oil or coal production would have an advantage only over quite long-haul imports or highly inefficient gas-based production. Nothing other than low-cost gas-based domestic production could compete with imports from the existing Japanese plants or even new Alaskan facilities if such units had the capacity to supply enough fertilizer to affect world prices significantly.

141. Distance is not the only factor in freight costs however. Another important consideration is the size of ship used, especially in the shipment of ammonia. For example, the use of a new 30,000-ton ship rather than a 7,500-ton vessel could almost halve freight costs. As this might reduce the landed price of ammonia by more than $ 30/ton over a distance such as Osaka-Bombay, the use of the larger ship could make domestic output uncompetitive with imports. As ship-size is less significant over short distances the development and exploitation of larger vessels in world ammonia and fertilizer trade is likely to favour producers in Japan, Alaska and elsewhere over those within an Asian subregion. For a country such as Indonesia, for example, economic export within the region may depend on its having a freight advantage over developed country producers. If an Indonesian plant could deliver ammonia or urea to Bangkok, Manila or Calcutta only a few dollars more cheaply, using small 6,000-ton ships, than could an Alaskan plant with gas at the same price but using large 35,000-ton or even 20,000-ton ships, the Indonesian export would need cost-savings other than those conferred by proximity alone.

142. A second transport-related basis for a subregional approach to fertilizer production might occur when costs of internal transport are higher than short-distance intraregional freight cost. Relatively high costs of internal or coastal transport could enable fertilizers or inputs from a subregional neighbour to be supplied to a district of a large country more cheaply than those produced domestically but in a less accessible district. In such cases the transport consideration may make subregional co-operation preferable to either self-sufficiency or import from more distant traditional sources. By influencing the direction of trade in this way and expanding the market for

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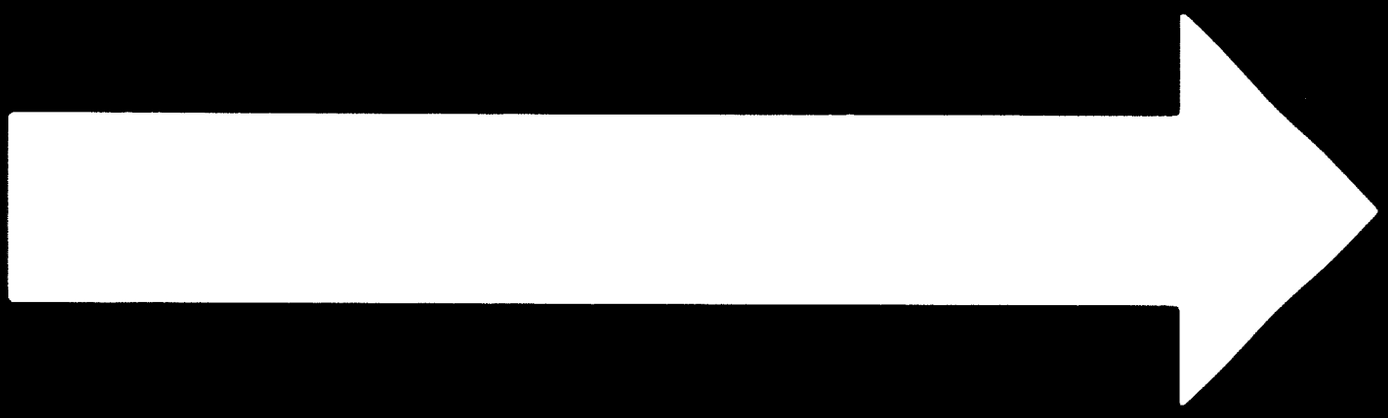

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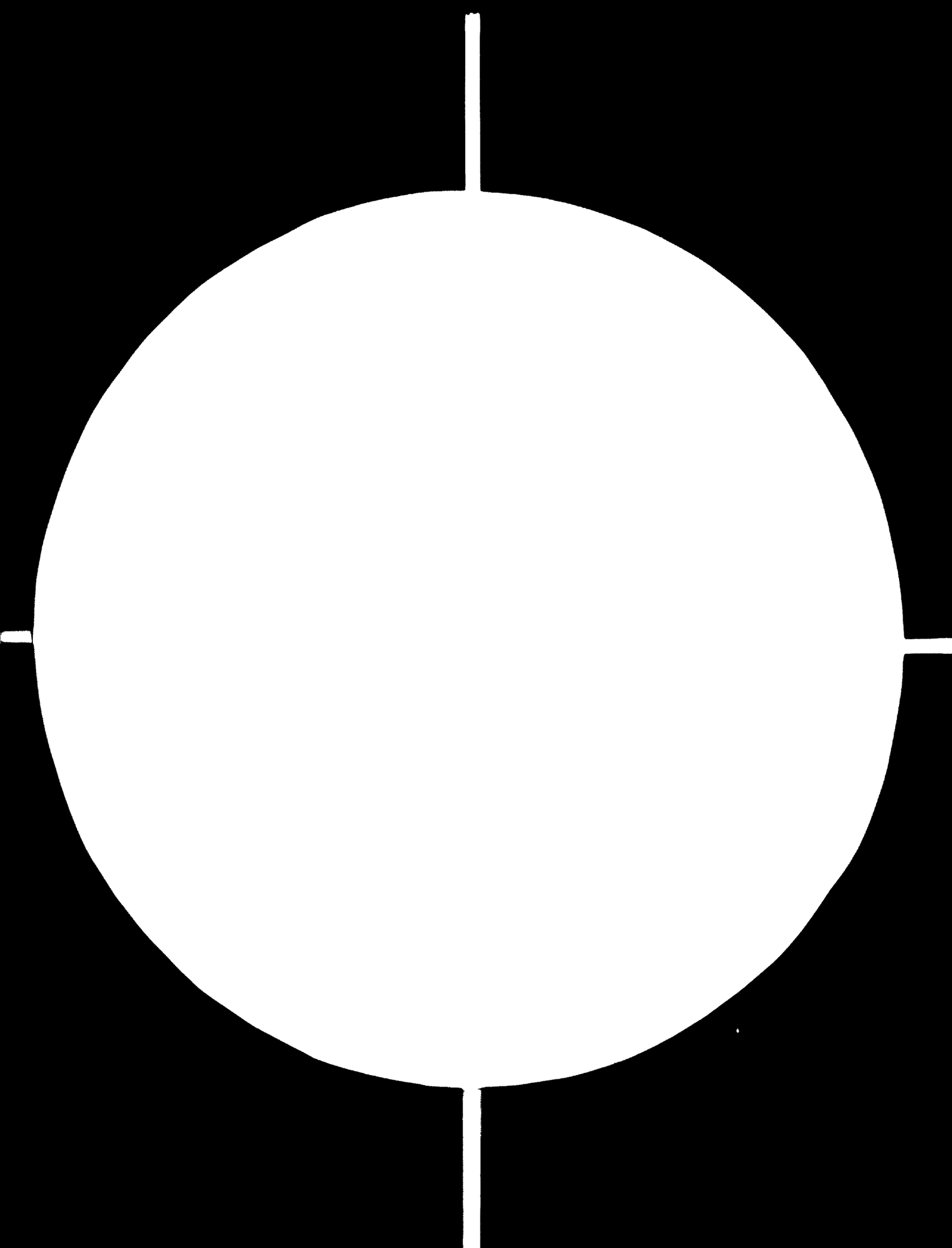

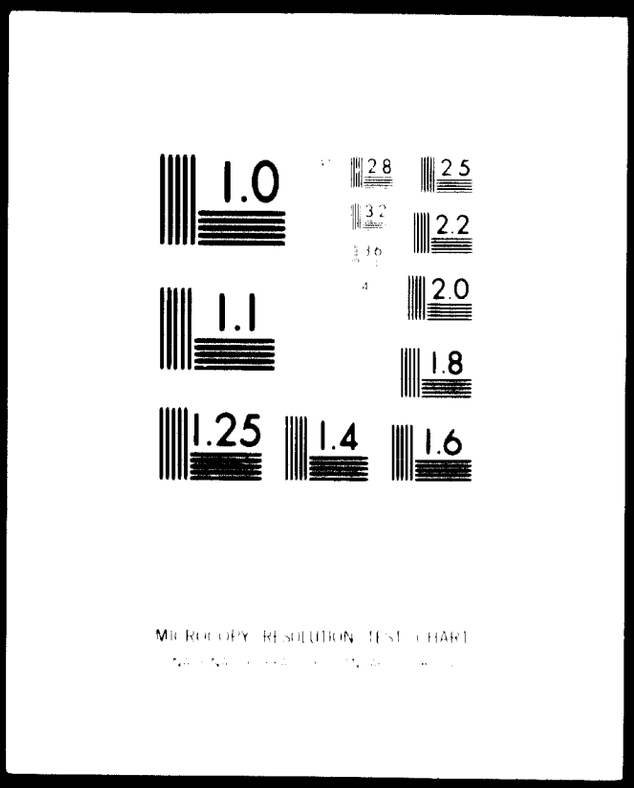

a plant's output, transport factors may affect the justifiable production scale, as well as location and the choice of feedstocks. In addition to its freight cost implications, an approach such as this (resulting perhaps in zero net imports) might help also to stabilize the flow of supplies over time in each country, inorder to reduce costs of storage or spoilage by diverting flows from one market to the other under an appropriate agreement.

143. The geography of the Indian subcontinent and surrounding producers (Burma, Iran, Afghanistan) could make the above approach profitable in that subregion. Similarly, a plant in the south of Thailand would be well-placed to serve the north and the east coasts of Peninsula Malaysia, while Sumatran plants would be closer than a Malaysian plant in Sarawak to the west coast of West Malaysia. Subregional co-operation to reduce supply prices in this way could be organized as a pool arrangement or a series of interlocking bilateral agreements. India's recent and current moves to participate in the new fertilizer industries of Bangladesh and Sri Lanka may be seen as first steps towards a geographic rationalization of this sort.

144. The costing of relative freight charges for the purposes of such an arrangement would be an extension of the exercises necessary anyway to determine optimal plant location for local production and consumption. In India, for example, it may be more feasible to site domestic plants in inland locations or close to some export ports while other districts close to other ports or transnational railways could be supplied with imported product. Because of internal transport costs it is not always economic to locate gas-based plants on the source gasfield, and it may be cheaper to transport gas in pipelines over quite long distances than to ship solid fertilizers from the feedstock source to the main consuming area. In the case of Bangladesh, for example, the primitive existing infrastructure might make the piping of gas as much as 300 km more efficient than investment in barges, railways and road vehicles necessary to ship urea to an area appropriate for distribution to consumers. The same consideration could make a well-developed harbour site such as Chittagong preferable to a gas-field site for an export-oriented plant.

145. This sort of consideration involves the third type of transport consideration affecting plant location: that concerning the relative costs of moving various feedstocks, intermediates and final products. The difficulty and (hence) high costs of liquifying, storing and shipping natural gas as LNG are well known.

/Other

Other commonly used hydrocarbon feedstocks are more portable, especially if they have to be imported anyway such as in the form of crude oil for refining into various products. However, coal is even more expensive to move because of its solid form and its low energy content per ton, requiring almost 2 1/2 tons to make a ton of ammonia compared with less than 1 ton of naphtha or fuel oil.9/

146. Natural gas, the cheapest hydrocarbon source when it is available, becomes a more expensive feedstock when it must be transported by sea since liquification, storage and shipping can equal its wellhead price and contribute about $ 20 to the price of each ton of N produced. This addition might make the feedstock cost comparable with that of fairly high-priced local coal not requiring shipping but costing (say) $ 30/ton coal. Over medium distances the LNG freight component in the resulting N would probably be higher than the cost of shipping ammonia, although perhaps somewhat lower than the cost of shipping a final product such as bulk urea. The advantage of LNG over other feedstocks increases markedly over much greater distances such as from Australia to the US west coast however. The c.i.f. price might still be little more than its cost following liquification, and even if both the wellhead prices and freight rates were quite higher, the transport component of the resulting N would be a good deal less than if it was shipped in the form of ammonia or urea.

147. Table 20 cites some illustrative figures to compare the impact on the price per ton N when various feedstocks, intermediates and products are shipped at specified nominal freight rates. It can be inferred that it is usually more expensive to ship N in the form of urea rather than ammonia or the equivalent amount of feedstock, between which there may be little difference. Over short distances the additional shipment cost for urea may amount to only about $ 10/ton N, while over long distances the difference may be about $ 70. In fact, the technical coefficients are such that this penalty for shipping N as urea rather than as ammonia or feedstock will always be about equal to the nominal freight rate itself.

148. Calculations such as these may be used to help determine the choice of feedstock and location of production facilities together. It can be seen that with low freight rates it would usually be cheaper for a country endowed

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9/ Cook and Vengala, in their Study of the Establishment of Nitrogenous Fertilizer Production in Developing Countries, UNIDO, ID 327, March 1975, take the respective figures as 2.30, 0.90 and 0.96 tons. With 0.6 ton of ammonia producing a ton of urea with 46 per cent N, the ratios to a ton of N would be 3 tons of coal, 1.1 tons of naphtha or 1.25 tons of fuel oil.

with fuel oil but not gas to import ammonia based on cheap gas rather than to produce its own ammonia with local $ 50/ton fuel oil contributing $ 62/ton N. However, when freight rates reach about $ 50/ton NH_3, local production of ammonia based on $ 50 oil becomes cheaper than import. In the case of a decision between importing 45c gas, or ammonia based on it, over a long distance, the high rates postulated in the table ($ 2/1,000 ft³ LNG and $ 70/ton NH_3) indicate an advantage for shipping the gas. Over a short distance, however, the relatively higher costs of gas liquification and storage should make the import of ammonia more profitable.

Choice of Product

149. Different costs of producing alternative vehicles for N and P_2O_5 form a less critical variable in investment decisions at the present time since the cost advantage of urea over other ammonia products is already established and reflected in present plans. The choice of fertilizer products must be dictated by particular soil requirements however, and the manufacture of ammonium sulphate and, to a lesser extent, nitrate will continue in the region. Thus it will continue to be necessary for developing ESCAP countries to take costs into account in planning production or import to meet the need for balanced and comprehensive application of fertilizers.

150. Another aspect of the problem of product mix is that compound fertilizers containing ammonia are becoming increasingly important, especially as vehicles for phosphates.[10/] There are several alternative forms of complex fertilizers among which selections must be made, and current technology also offers choices of mixing process. The selection of appropriate NPK mixtures or compounds to be produced or marketed depends on a variety of agricultural factors such as the results of soil research, recommended doses for particular crops and the distribution infrastructure. These factors need to be balanced against estimates of the minimum marketable quantity of each of the many NPK ratios which are technically feasible, and cost-benefit calculations are necessary also in order to discover the circumstances under which stable markets may be developed for the more expensive compounds in place of single- or dual-nutrient fertilizers.

/151.

10/ Inter alia the ammonium phosphates include: granular or powdered monoammonium phosphate (MAP), diammonium phosphate (DAP), ammonium polyphosphate (APP), and even urea-ammonium phosphate (UAP). The older vehicles for P_2O_5 are single superphosphate (SSP) and triple superphosphate (TSP).

151. The various ammonium phosphates may be compounded downstream or produced in dual nutrient plants. Thus items eligible for specialization and exchange include the intermediates ammonia and sulphuric and phosphoric acid as well as more final products. For this reason decisions on plant investment should not restricted to the transformation of hydrocarbons into urea, and of rock plus H_2SO_4 into simple phosphatic fertilizers. Most countries in the region already engage in downstream activities, and a regional pattern of future investment could include both the expansion of this practice coupled with specialization in more basic processes. The raw materials endowment, scale, location and other cost factors may well have different impacts on the efficiency of various operations. Thus the form in which the nutrients are delivered to the farm may affect the feasibility of investment in one country or another.

152. The various data cited in this chapter illustrate the several cost factors in addition to the choice of raw materials and feedstocks which require careful study in the formulation of investment decisions on what fertilizers to produce domestically, if any. Although the conclusions to be drawn will differ between particular cases and on account of the interaction among the factors, a dozen propositions may be cited as generally valid:

(i) the use of gas rather than other hydrocarbons usually has advantages with respect to both investment and operating costs;

(ii) developing countries begin with a disadvantage because of higher capital costs of installation;

(iii) this is likely to be compounded by inadequate infrastructural facilities;

(iv) plants established over the next decade will cost several times as much to build as those already existing;

(v) unit costs are raised sharply by under-utilization of installed capacity;

(vi) there are significant economic returns to scale, especially in urea production;

(vii) shorter distances should give subregional output an advantage over imports from industrialized country suppliers;

(viii) this advantage may be eroded by the development of bulk transport in large vessels;

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(ix) high internal freight costs may justify trade across borders not necessarily resulting in net import;

(x) gas and coal are less portable than other hydrocarbons although, once liquified, gas can be transported over long distances at little extra cost, and even without liquification gas can be piped more efficiently than solid fertilizer can be carried if infrastructures are well;

(xi) the shipment of nitrogen in the form of urea is usually more expensive than as ammonia or the equivalent feedstock; and

(xii) as production costs differ among fertilizer products, a pattern of output including various raw materials, intermediates, basic fertilizers and compounds should develop on the basis of raw materials availability, access to markets and other elements of comparative advantage.

It is the quantification and application of considerations such as these to particular situations which should determine both the feasibility of individual facilities and the development of a regional fertilizer industry aimed at exploiting indigenous resources to put nutrients into Asian soil as cheaply as possible.

/PART C:

PART C: SELF-SUFFICIENCY AND CO-OPERATION

Chapter 7: Supply-Demand Balances

1979/80 and Beyond

153. We have seen in the preceding two parts, notably chapters 3 and 4, that both demand and supply for nitrogen and other chemical fertilizer nutrients are expected to expand rapidly in developing ESCAP countries over the coming decade and a half. In this chapter some possible supply/demand balance situations in 1979/80 are postulated, mainly as a guide to the amount of further expansion in production facilities which may be needed in the eighties. The 11 countries which have been under principal consideration in the UNIDO/ESCAP priority project are considered separately, with their general ambition of approaching self-sufficiency in mind. The possibility of production in Singapore is also considered. The following chapter 8 then deals with expected shortages and surpluses from a collective point-of-view in order to discuss their implications for intraregional trade, while chapter 9 focuses on the scope for explicit subregional economic co-operation to maximize the benefits of such trade.

154. Table 21 derives 1973/74 and 1979/80 supply-demand balances for nitrogen in the 11 ESCAP countries under consideration. For the 1973/74 fertilizer year each country's balance is estimated by the Expert Group as the surplus of output over consumption, using official FAO statistics as reported in tables 11 and 14. For the 1979/80 year, however, the production estimates are those stated in table 15, while five sets of demand estimates are selected from table 12 for comparative purposes. Using the Expert Group's estimates, the resulting balance would be a gross surplus of almost 0.6 million tons N. This would comprise surpluses in Iran, Afghanistan, each of the four South Asian countries, and Indonesia, with shortages totalling 0.4 million tons in the other three ASEAN members.[1/] A least-squares exercise on consumption would double the group's surplus to over 1.3 million tons N, due mainly to smaller demand in Indonesia, Iran, Pakistan and the Philippines than was assumed by the Expert Group.

/155.

1/ Singapore is not included in this analysis as its consumption is insignificant and production plans uncommitted.

155. An even broader range appears in the supply-demand balance calculation when the sum of the highest demand estimates for each country is compared with the sum of the lowest. The latter implies a group surplus of over 1.6 million tons N in 1979/80, with deficits only in the Philippines, Malaysia and Thailand. The high-consumption sum, on the other hand, would actually leave the group with a small overall deficit, with India and (marginally) the Republic of Korea joining Malaysia, the Philippines and Thailand in that condition, while the Indonesian and Pakistani surpluses would be smaller. The use of the fairly arbitrary mid-point between the highest and lowest estimates for each country would produce results similar to those made by the Expert Group but with some differences in magnitude resulting in a larger overall surplus of 0.8 million tons N.[2/]

156. In considering balances and potential new capacities in the 'eighties, more accurate demand estimates are clearly needed, but in their absence the Expert Group and the mean estimates of table 12 may be used for illustrative purposes. These provide two indications in table 22 of each country's possible surplus or deficit in N in 1984/85 and in 1989/90 in the absence of new installations beyond those assumed to be on stream by 1980 (with production levels as shown in table 15). Depending on which demand estimates are used, the overall deficit by mid-decade may be between 2.4 and 3.4 million tons N, increasing to between 7.0 and 9.3 million by the end of the decade if no new capacity were installed during it. India would account for the lion's share of the group deficit, but all other countries except Iran would retain or develop requirements in excess of their 1980 production capacity.

157. Table 22 shows also the [illegible] of new capacity which would need to be installed after 1980 if each country were to achieve or retain self-sufficiency through 1984/85 and 1989/90, assuming no inter-country trade to offset deficits against surpluses. During the first half of the decade new capacity would be needed in India, the Philippines, Malaysia, Pakistan and Thailand (and perhaps in Indonesia, the Republic of Korea and Sri Lanka as well). India's needs would justify the equivalent of about 11 standard-size ammonia/urea complexes,[3/] the Philippines may need one or two, and one each would suffice

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2/ It is interesting to note that in a more comprehensive 35-country exercise conducted in the Asian region more recently than the field work for the UNIDO/ESCAP Priority Project, total capacity for urea production is expected to be 6.7 million tons urea while consumption is projected at only 1.3 million tons. Thus consumption in the 35 countries would account for only 20 per cent of this capacity which, if it were operated at an average utilization rate of 80 per cent, would produce over 4 million tons of surplus product, containing about 1.8 million tons N.

3/ 1,000 tons NH_3 and 1670 tons urea/day, yielding 200,000-260,000 tons N/year.

for Malaysia, Thailand and Pakistan. The sum of the deficits of these five countries would total between 3.5 and 4.5 million tons N, again depending on demand.

158. Assuming that this capacity were put in place by 1985, the same five countries would require the following numbers of additional complex-equivalents to meet rising demand during the second half of the decade: India between 16 and 24; the Philippines none if two had been installed earlier; Malaysia and Thailand each 0.5; and Pakistan two. In addition, requirements for other countries would have appeared, viz: Indonesia two; Korea and Bangladesh about 0.5 each; and small amounts for Afghanistan and Sri Lanka. The additional requirements between 1985 and 1990 for all the deficit countries (i.e. all countries except Iran and perhaps the Philippines) would amount to between 5.8 and 7.4 million tons N. This would bring the total of new capacity needed during the whole decade to between 8.9 and 12.0 million tons of nutrient.

159. With respect to phosphatic fertilizers, the demand and supply estimates given in tables 13 and 15 are compared in table 23 to indicate a deficit for each of the 11 countries and a regional deficit of just over 1 million tons P_2O_5 in 1979/80. In contrast to nitrogen, the phosphate deficit is getting larger, partly as a result of efforts to ensure a better balance of nutrients in fertilizer application in several countries of the region, especially Indonesia, Pakistan and India. Table 23 also compares the estimated demand for P_2O_5 in 1984/85 and 1989/90 with the estimated output of facilities in place by 1980. Although self-sufficiency is a more notional concept in phosphate than in nitrogen production for most countries, the table indicates the additional production capacities (or imports) which would be needed during the periods 1980-1984/85 and 1985-1989/90. New capacities needed in the group as a whole, in order to attain self-sufficiency, would total about 3 million tons P_2O_5 in each half of the decade.

160. By 1984/85 each country except Afghanistan and Sri Lanka could support at least the equivalent of one 400 ton/day P_2O_5 plant, nine of which might produce almost 1 million tons P_2O_5. In addition, there would be hypothetical scope for 13 more such plants in India, three in Indonesia and one each in Pakistan, the Republic of Korea, and perhaps Thailand producing a further 2 million tons P_2O_5. The extra requirements expected to develop during the second half of the eighties could hypothetically be met by a further 19 plants in India, two in Indonesia, one each in the Republic of Korea, Pakistan, Thailand and Malaysia, together accounting for all but 0.4 million tons of the group's 1985-90 consumption growth.

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The Case of ASEAN

161. In order to investigate the scope for both self-sufficiency and subregional co-operation in more detail, a trial run exercise on the supply-demand balance situation in the ASEAN subregion was included in the UNIDO/ESCAP priority project work. The exercise compared high, mid-point and low projections of the growth of domestic consumption, with various plant-establishment and capacity-utilization possibilities. It produced 27 hypothetical 1980 and 1985 supply/demand balance estimates for each of the five countries (including Singapore), excluding many possible combinations for the subregion. Several such possibilities are summarized here to provide a basis for an illustration of self-sufficiency problems and of trade opportunities and subregional co-operation discussed in the following chapters. The illustrative possibilities are quantified in tables 24 and 25.

162. First let us consider the extreme case where installation plans are rapidly implemented and high utilization rates achieved while consumption grows slowly in each country. It is useful to see, for example, that by 1980 Indonesia achieves full capacity utilization in its Pusri I, Pusri II and Iskandar Petrokimia (Gresik) plants and also in the Pusri III, East Kalimantan I, East Kalimantan II and West Java I plants, and that by 1985 the proposed Pusri IV, Pertamina (Port Dickson), and Pertamina II (East Borneo) plants are also on-stream at full capacity. Meanwhile each of Malaysia, the Philippines and Thailand is assumed to have expanded output by debottlenecking existing plants by 1980, and to have brought a new complex fully on stream by 1985, when Singapore also may have a plant in operation, based on naphtha. In this situation table 24 (a) shows that, with ASEAN consumption totalling 6.8 million tons N in 1980 and 11.3 million tons in 1985, the subregion would experience overall surpluses of 1.6 million tons in 1980 and over 4.3 million tons in 1985. The 1980 surplus would occur after Indonesia's large excess supply had offset moderate deficits elsewhere, while in 1985 all countries would be in surplus.

/163.

163. The other extreme provides a second illustrative situation. Here it is assumed that either intentional or accidental delays in installation and poor utilization of capacity occur in the face of strong expansion of consumption in each country. Of the 10 Indonesian plants mentioned above only five are in operation by 1980 and a further two by 1985, while the other countries are assumed to proceed only with improvements to existing facilities. Under such circumstances, high ASEAN consumption levels of 1.4 million tons in 1980 and 2.2 million tons in 1985 would result in subregional deficits of 0.5 million tons in 1980 and almost 0.8 million tons in 1985. These overall results would include small deficits in Indonesia but substantial import requirements in the other consuming countries, especially the Philippines, as table 24 (f) shows.

164. If the production and consumption assumptions were reversed in the above two situations, more balanced results would occur. With rapid expansion of both production and consumption, as in table 24 (e), the subregion would still be in surplus in both years, but only by 0.4 million tons in 1980, (i.e. about half the extent that would have existed with low consumption) and about 1.4 million tons in 1985 when each country's surplus would be lower or, in the case of the Philippines, transformed into a substantial deficit by that country's extraordinary growth in consumption. On the other hand, table 24 (f) indicates that low consumption growth would more than avoid the overall deficits that would otherwise occur in the low production case, yielding surpluses of 0.1 and 0.15 million tons for the subregion by including comfortable surpluses in Indonesia and reduced deficits in Malaysia, Thailand and especially the Philippines. These are only two examples of the many possible subregional supply-demand balances which could occur, since in the case of neither production nor consumption are the high and low estimates likely to occur in each country. For the purposes of the following examples of such possibilities, medium consumption levels totalling about 1.1 million tons in 1980 and 1.75 million tons in 1985 are assumed in order to focus the discussion on alternative production combinations.

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165. To begin again with extreme situations, table 24(b) shows the results of high installation and utilization performance in all countries, while table 24( ) shows the low production counterpart. In the former situation a subregional surplus of 0.7 million tons in 1980 would rise by a further 1.8 million tons by 1985, when all countries would be in surplus except for a relatively small deficit in the Philippines. On the other hand, low production growth would yield comparable deficits of 0.2 and 0.3 million tons in the two years -- and these could be removed by improvements in utilization without major new investment.

166. A more reliable approach to the overall balance of the subregion's supply and demand would include rather more rapid installation of new capacity in Indonesia and perhaps elsewhere however. Leaving aside to chapter 8 the issue of intra-ASEAN trade and co-operation, a scenario may nevertheless be outlined to achieve subregional self-sufficiency with plant location determined on economic rather than national self-sufficiency criteria. The 1.1 million tons by which the group is assumed to be ready to consume in 1980 could be almost fully supplied by Indonesia bringing its Pusri III and East Kalimantan floating plants on stream with about 95 per cent utilization in all five plants by that year, and by Malaysia, the Philippines and Thailand achieving high utilization rates in existing facilities and in minor expansion projects. The additional 750,000 tons required by 1985 could be produced through investment in three new complexes phased in successively during the 1980-85 period to match the growth in demand. These could be sited in any of the five countries: one possibility would be to proceed with the planned East Kalimantan II and West Java plants, achieve moderate utilization rates, and locate one plant in either Sarawak, Songkhla, the Philippines or Singapore. Of these, the former is chosen for the purposes of the example in table 25(a).

167. Alternatively, a more self-sufficiency solution can be postulated, with each ASEAN country attempting to produce just enough nitrogen to satisfy its domestic demand and without hope of export either within or beyond the subregion. In this case Indonesia would need to bring only the East Kalimantan floating plant on-stream by 1980 and then to add Pusri III by 1985 and East Kalimantan II later. With these plants

operated

operated efficiently the country might still have small surpluses in each year, avoidable by careful inventory-control and synchronization of start-ups with consumption growth.

168. However, for the other countries with smaller consumption levels, the problem of matching supply and demand would not be soluble in this way. Indeed, in the case of Malaysia and Thailand, self-sufficiency could not be attained at all without recourse to small, less efficient plants, since it would not be until the late eighties that either of these countries could fully support a 250,000 ton N plant of its own. However for the purposes of table 25(b) Malaysia is assumed to be bringing a full-size plant on stream in 1985 with a 95 per cent utilization rate in that year; while Thailand is assumed to wait until its demand grows beyond 1985 before installing new capacity. The Philippines could do so in 1980 however and could perhaps justify a further such plant coming on full stream soon after 1985. Moreover since the Philippines lacks natural gas supply, its indigenous production, if any, might occur in smaller plants with less scope for economies of synchronization. Alternatively approximate balance could be achieved by improvements in utilization after the first new complex was introduced.

169. If each small country were determined to avoid dependence on imports of nitrogenous fertilizer altogether, and to take the risk of consequent surpluses, a more active installation programme would be necessary. But over the run the risk of short-falls if demand were to expand rather better than expected, Indonesia would need to bring its East Kalimantan II plant on-stream rather earlier, say by 1987, thus raising output sharply even if efficiency fell to some extent. The Philippines would have to bring a full-sized complex on-stream by 1980 and then raise utilization rates to high levels in order to meet consumption growth up to about 1984. It would then need to introduce its second new complex in the middle of the decade and either operate it well below an efficient rate of utilization, or deal with large resulting surpluses, until domestic consumption caught up a few years later. Malaysia and Thailand, with their smaller home markets, would be in an even more difficult situation. In each case a new complex would need to be commenced immediately but then would either have to operate inefficiently, or produce substantial surpluses. These would amount to up to 0.5 million tons for the subregion, as table 25(c) shows.

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This dilemma would persist for almost a whole decade unless the rate of growth of demand were changed significantly or there were really opportunities to export the large surpluses. The possible scope for the latter solution is examined in the following chapter.

/Chapter 8:

Chapter 8: Scope for Trade

The Present Decade

170. On the basis of the previous consideration of anticipated supply-demand balances and additional capacity required through the next decade and a-half, this chapter describes the scope for intra-regional and external trade on the part of the 11 countries already discussed, plus Singapore where appropriate. As before, the rest of the seventies and the following decade are treated separately, with the present section concentrating on the trade implications of the supply-demand balances which have been postulated for the 1979/80 fertilizer year. In the second section, some trade possibilities for the eighties are considered and attention is drawn to the main factors which should encourage trade-oriented approaches to the industry's development. Again, the chapter concludes with a more detailed look at the ASEAN subregion.

171. The scope for intra-regional trade over the next four fertilizer years appears limited to the following, if indeed it occurs at all:

(i) the partial replacement of external supplies of nitrogenous fertilizer (mainly from Japan) to Thailand, Malaysia and the Philippines by some of the offtake from the new Indonesian capacity;

(ii) the purchase of new Bangladeshi and Sri Lankan output of urea and other nitrogenous fertilizer by India, at least until the latter's own new facilities come on-stream and perhaps beyond;

(iii) some product-specialization and/or exchange of intermediates among producing countries; and

(iv) some trade in products across borders, because of transport cost differentials, without necessarily affecting net nutrient balance positions.

172. Meanwhile, the general external trade prospect is for a decrease in most developing ESCAP countries' imports of nitrogenous fertilizer as the output of the new facilities already under construction in the region closes the gap between the countries' domestic production and consumption in spite of the expansion of the latter which is expected to occur. Unfortunately this reduction in dependence on imports probably will be occurring concurrently with a gradual fall in world prices from their high 1974 levels, raising

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problems of competition in domestic markets for most countries in the group, and more serious problems of external disposal for those which will have gone into surplus by the end of the decade. Meanwhile imports of phosphatic and potash nutrients in either intermediate or fertilizer form should increase, since demand for the former is likely to grow faster than supply within the group, while production of potash is not expected to occur within the region until the next decade.

173. As we have seen, at least six of the 11 countries under consideration should turn their present deficits of nitrogen into surpluses by the end of the present decade. Only Malaysia, the Philippines and Thailand are likely to remain net importers. In their present condition, the projections of India's consumption and production are too uncertain to indicate that large country's likely balance at the end of the decade: while the Expert Group calculations suggest a surplus of over 0.2 million tons N, high consumption growth or slow progress on new installation and debottlenecking activity could produce a deficit which some forecasters have suggest will exceed the present 0.8 million tons N. In the absence of better data India is assumed to have balanced supply and demand in 1979/80, at least after the execution of current proposals to participate in the offtake of Sri Lanka's new plant. Apart from the Republic of Korea, which could have a small deficit in place of the expected surplus, the other countries should be net exporters, or have scope to expand their own demand rather more than expected.

174. The combined deficit of the three ASEAN countries with shortages is expected to be between 0.2 and 0.5 million tons N in 1979/80, whereas the surplus of their ASEAN partner Indonesia may fall in about the same range, yielding an over-all balance for the subgroup. Instead, however, there could be a surplus or a deficit of up to 250,000 N (a difference about equal to the output of two standard ammonia/urea complexes) if consumption is sluggish on the one hand or vigorously expanded on the other. The small local markets of Thailand and Malaysia rule out nutrient production for domestic needs alone in these countries: their main option is between producing with export in mind or importing from Indonesia or elsewhere. In the Philippines' case, lack of cheap feedstocks should inhibit investment in nitrogen production in spite of there being a sufficiently large domestic demand to consume the offtake of at least one full-sized ammonia/urea complex. Considerable intra-regional trade in nitrogen within ASEAN can therefore be envisaged in the late 'seventies and early 'eighties, with scope for either import from or export

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to countries outside the subregion as well. It must be born in mind, however, that each of the importing countries has plans for its own ammonia/urea complex already under consideration: to the extent that any of these come on-stream subregional trade will be reduced, and the need to seek markets beyond the group in order to export possibly high-cost surpluses will arise.

175. In contrast, and subject to domestic consumption levels approximating the Expert Group or Mean magnitudes postulated in table 11, all six South and Southwest Asian countries in the group are expected to be in surplus for nitrogen in 1979/80. These country-surpluses could range from less than 0.1 million tons N in Afghanistan and Sri Lanka to 0.2 million tons N or more in Iran and perhaps Pakistan, Bangladesh, India again. As noted above the Indian situation is very hard to predict, since many factors could cause it to vary from the small surplus expected by the Expert Group. Using the Mean magnitudes for consumption, these six countries appear from table 21 to have an expected combined surplus of 0.8 million tons N, give-or-take the equivalent of one standard ammonia/urea complex. Since each would be self-sufficient on a net basis, any intra-regional trade would be limited to that based on product specialization or the internal transport cost factor, while the large combined surplus would need to be exported beyond the subregion. Some of it might be taken by the ASEAN subregion if vigorous expansion of demand there outstripped local production, but this would at best account for a quarter of it and would require that it could be landed competitively with supplies from other sources. The latter consideration would be even more significant if it were hoped to sell the South Asian surplus to extra-regional consumers farther away.

176. A very different picture arises in the 11 country group with respect to phosphatic fertilizers. The present combined deficit of 0.7 million tons P_2O_5 is expected to increase to over a million tons by 1979/80, when all countries except perhaps the Philippines and Sri Lanka will be net importers. Indonesia will need to import 0.2 million tons P_2O_5 and India rather more, while each of Thailand, Malaysia, and the Republic of Korea, Pakistan and perhaps Iran will require about 0.1 million tons. These circumstances provide little scope for intra-regional trade by 1979/80, except on the basis of product specialization, trade in raw materials, and possibly sales from the Philippines to Indonesia and from Sri Lanka to India if production is expanded more than now anticipated. However extra-regional trade will continue on a significant

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scale until production within the region is further expanded in the 'eighties. This is even more true of trade in fertilizers containing potash nutrients, since the only potential suppliers within the region, Thailand and perhaps neighbouring Laos, are not expected to have their deposits exploited by the 1979/80 fertilizer year.

177. The 11-country group's over-all nitrogen surplus of between 0.6 and 1.4 million tons N anticipated to occur in 1979/80 would not be a cause of concern if there were likely to be ready export markets in the vicinity. But as table 26 shows, Japan is likely to have a large positive supply-demand balance as a result of China's approach to self-sufficiency. As early as 1975 moreover, Japanese suppliers have begun to lower prices to levels which will be difficult for domestic plants in Southeast Asia to meet. Other regional sources of fertilizer product on the world market, arising from domestic surpluses, could include Burma and Brunei, both of which have under consideration new capacity to produce nitrogen from their natural gas reserves. The arrival of these presumably low-cost supplies on regional markets could be particularly serious for surplus producers in Southeast Asia because of their comparable transport costs.

178. This ready availability of nitrogen in the ESCAP region as a whole will present three problems for surplus producers among the 11-country group under consideration:

(i) the prospects for export to Asian countries outside the group are very low;

(ii) surplus producers outside the group will be competing for markets in the few countries within the group which are likely to have shortages - and these deficit countries could become self-sufficient early in the eighties anyway; and

(iii) domestic production may sometimes not be competitive even in its home-markets, necessitating producer-subsidies or protective arrangements which would prevent farmers from gaining access to cheaper products imported from other Asian or Middle East surplus countries.

These problems do not arise in the case of phosphatic fertilizers, since the 11 countries are expected to be in over-all deficit of a million tons P_2O_5 in 1979/80 while table 27 indicates that other Asian countries' combined surplus may total only half of this amount.

/179.

179. It appears therefore, from the estimates of production increases and expansion of domestic demand levels over the rest of the present decade, that there will be relatively little scope for intraregional trade except within the ASEAN subregion. It must be emphasized however that rates of growth of demand, or indeed of supply, would not need to differ very much for quite different nitrogen balances to appear in the larger countries, especially India. As the first 1979/80 column in table 21 shows, India's expected surplus would be replaced by a deficit if a high consumption level were achieved, and in view of the need to raise food output vigorous efforts are desirable to make performance conform to this projection. In such a case India might remain dependent on imports to the tune of at least 0.1 million tons N - about equal to the expected surplus of Bangladesh or Pakistan or Iran under similar demand assumptions - and perhaps much more.

180. Otherwise, an over-all surplus of more than 0.3 million tons would remain in South Asia in 1979/80, but as this would be less than the deficit which could occur in ASEAN under similar demand assumptions, it is conceivable that vigorous demand expansion in all 11 countries, plus the organization of trade between these two subregions, could yield an approximate balance instead of the million-ton surplus discussed earlier. This alternative scenario involves a very different degree and pattern of intraregional trade than that based on more moderate demand estimates, indicating the urgent need for detailed research to yield more precise and reliable predictions both of demand levels and of the availability and likely cost of supplies from various sources within and without the group.

The Next Decade

181. Demand projections are naturally even less reliable for the eighties than they are for the coming four fertilizer years. However, basic food production requirements will dictate certain minimum levels which are likely to be exceeded if governments maintain present development intentions, and

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especially if increased output keeps fertilizer prices within reasonable levels. The 1984/85 and 1989/90 supply-demand "balances"[1/] in table 22 may prove therefore to be fairly realistic reflections of the growth of consumption in the 11 countries. If so, the real balances available for intraregional and/or extraregional trade during the eighties should depend mainly upon:

(i) the extent to which governments judge it desirable to commit the new investment which would be required for each country to attain self-sufficiency; and

(ii) the amount of further investment in facilities designed to produce for export in order to transform raw materials endowments into foreign exchange.

182. For the 11 countries as a whole, self-sufficiency would require the installation of between 9 and 12 million tons N of capacity during the next decade - in addition to that which exists already or will have been established by 1980. However, about three-quarters of this is attributed to India which, because it lacks low-cost indigenous feedstock resources, needs to adopt a cautious approach towards decisions on the installation of so much capacity for fear of dissipating scarce capital on unnecessarily high-cost home production. The Philippines is in a similar situation, and even some of the countries with natural gas, such as Thailand. These may find that considerations of the opportunity cost of investing capital in the fertilizer industry, or the desirability of developing a specialization in other aspects of the fertilizer industry according to comparative advantage, give imported urea or at least ammonia a significant advantage over domestic production. For these reasons there is a good chance that several of the 11 countries will produce a good deal less domestic nitrogenous fertilizer than the hypothetical self-sufficiency exercise in table 22 suggests. This is even more certain in the case of phosphatic fertilizers, in the production of which it is highly unlikely that most countries will approach the levels suggested in table 23.

/183.

1/ These "balances" are not projections as in the case of table 21 covering 1979/80. The Expert Group and Mean figures for 1984/85 and 1989/90 represent the differences between demand in those years and the levels of production which are assumed to be established in 1979/80.

183. On the other hand, some of the countries have endowments of raw materials which favour production of ammonia and urea well in excess of domestic needs. These include Iran, Bangladesh and Pakistan in South Asia, and Indonesia and perhaps Malaysia in ASEAN. For phosphatic fertilizers, the Philippines appears capable of establishing facilities with output far above the 134,000 tons P_2O_5 which is all it will need for self-sufficiency as late as 1990. Thus the 11-country group's needed 10 million tons N or so of new nitrogen-capacity to be installed during the eighties, and that part of the needed 6 million tons P_2O_5 of new phosphate-capacity which can be installed, are unlikely to follow the patterns suggested in tables 22 and 23 as a result of the countries' pursuit of self-sufficiency considerations alone. Indeed, a considerable amount of intraregional trade appears not only desirable, but likely to occur if regional and subregional arrangements based on comparative advantage can be concluded in time to affect investment plans.

184. A third important element of the likely situation with implications for trade is that the group includes several countries for which domestic self-sufficiency will require relatively small amounts of new capacity during the eighties. In the cases of Afghanistan, Sri Lanka, probably Bangladesh and perhaps the Republic of Korea, the additional nitrogen capacity needed is expected to be less than 0.1 million tons each. Since a urea complex of economic scale produces about 0.25 million tons, these countries have the option of installing capacity to produce largely for export, or of importing their additional needs. The availability of both markets and competitively produced supplies within the region suggests that the resulting trade - whether export or import - could be intraregional and probably subregional.

185. Other countries in the group also would be liable to participate in trade of amounts smaller than the output of one complex, even if they preferred a self-sufficiency policy. For example, Thailand, which is assumed in table 22 to have installed no new capacity by 1980 but to be able to justify one new complex about 1985, would develop new import needs as consumption growth outstripped the capacity of this new complex in the ensuing years. This would apply also to Malaysia, and even to much larger countries and others with heavy domestic production programmes. Temporary shortages and surpluses will necessarily occur as a result of production rising by large increments while consumption grows more steadily. The better these temporary imbalances are predicted, the more likely that each country can schedule its installations to ensure steady supplies for itself, and thus the group as a whole, through trade.

/187.

capital and the natural gas which a nitrogenous fertilizer complex would consume in other import-substitution or export-oriented industries. For some countries, of course, fertilizer may be a most appropriate avenue for investment of capital and exploitation of indigenous raw materials - and this possibility is enhanced if their neighbours do not all select the same industry and thus deny them the opportunity to export.

ASEAN Trade Flows

189. The ASEAN subgroup entered the second half of the seventies with combined annual production levels of about 0.25 million tons N and 0.05 million tons P_2O_5. Through improvements in utilization rates of existing capacity the former could be raised towards 0.5 million tons N, while a further 0.5 and 0.05 million tons could be added through new installations to bring 1979/80 output to 1.0 million tons N and 0.1 million tons P_2O_5. It appears that this will satisfy most of the subregion's demand for nitrogen in that year, although only a small proportion of the phosphate requirement. However consumption growth during the eighties should justify the installation of further nitrogen capacity to produce at least an additional 1.0 million tons N, and perhaps half as much again, by 1989/90. A further 1.0 million tons P_2O_5 also could be absorbed within the subregion, which, like the rest of Asia, will have an increasing demand for potash as well.

190. Unfortunately, a much clearer picture than the above is necessary to ensure optimal investment and trade pattern, at least in nitrogenous fertilizer production. Several possible supply-demand balance situations for nitrogen in the five ASEAN countries were suggested in chapter 7 above, purely as illustrative examples pending the more sophisticated projection of expected levels. Their trade implications are observed here, although discussion of subregional arrangements which may be desirable to facilitate such trade flows is deferred to the following chapter 9. For convenience the order adopted in tables 24 and 25 is adopted to summarize the subregional and external trade flows which could result from the nine alternative combinations of production and consumption levels. In addition to such flows in what is assumed to be a single product, there could be scope for specialization and other bases for trade involving fertilizers.

191. In the three situations characterized by rapid installation of new facilities and high utilization rates, there is considerable scope and need for both subregional trade and export beyond ASEAN regardless of the rate of growth

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of consumption. If the latter is relatively low, Indonesia would provide about 0.2 million tons N to its neighbours and sell 1.0 million tons abroad in 1980, and five years later all five countries would have to export a total of over 2.3 million tons. With medium consumption Indonesia's subregional provision in 1980 would rise by 50 per cent and its amount available for external export would drop to 0.7 million tons; in 1985 four of the countries would export 2.0 million tons, including 0.1 million tons to the Philippines. High consumption would yield greater subregional trade - almost 0.5 million tons from Indonesia in 1980 and over 0.2 million tons to the Philippines in 1985 - but less extraregional trade amounting to 0.4 and 1.4 million tons in the two years.

192. Quite different trade patterns, especially in 1985, are implied by the assumption of delayed installation and poor utilization of capacity. In 1980, low consumption would allow a flow of 0.3 million tons to Indonesia's neighbours and only 0.1 million tons abroad. With medium ASEAN consumption, however, Indonesia would fall short of meeting its neighbours' deficits by 0.2 million tons after supplying its 0.2 million tons surplus to them; while with high consumption Indonesia would just achieve a domestic balance and the other countries would need to import 0.5 million tons from outside. Five years later the intra-regional flows would be slightly higher but there would still be net deficits totalling 0.3 million tons with medium consumption or almost 0.8 million tons with high. These net deficits could be readily reduced to insignificant levels however, merely by utilizing the installed capacity more efficiently and perhaps adding one more complex about the middle of the decade.

193. Assuming medium consumption, it appears therefore that if all countries proceeded with rapid development plans, by 1985 there would be little scope for trade within the subregion and a very large surplus for which other markets would have to be found. On the other hand if all countries adopted a highly cautious approach to investment in the industry, Indonesia and an external source such as the Persian Gulf or Japan could share equally the total 0.7 million ton import requirement of the Philippines, Malaysia and Thailand. With some variation on the latter approach, along the lines suggested in paragraph 166 of chapter 7 above, the subregion could achieve an over-all self-sufficiency in nitrogen in 1980, and maintain this through the middle of the decade. This could be on the basis of supplies from Indonesia and, in 1985, one other ASEAN member, to the deficit countries which might specialize in another fertilizer product. The

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186. Specialization among nutrients provides yet another basis for intraregional trade, necessarily associated with subregional co-operation since harmonization of investment plans in advance must occur to avoid the installation of comparatively disadvantaged plants. The most obvious example, since its raw materials basis is already known and intergovernmental discussions have been commenced, consists of the bilateral exchange of nitrogenous and phosphatic products or intermediates between Indonesia and the Philippines. Indeed, this exchange based on nutrient-specialization forms an important element of a possible broader ASEAN fertilizer production programme which could take nutrient-specialization as its main but not sole theme. The expected exploitation in Thailand of salts containing the third primary nutrient, potassium oxide should enhance considerably the subregion's over-all self-sufficiency in nutrients and, by permitting multi-directional trade, improve the basis for the equitable distribution of benefits among the associated countries.

187. As well as specialization in different nutrients through trade in the raw materials, intermediates or products associated with them, there may be scope for the exchange of goods within a nutrient group. Attention has been drawn in chapter 5 to the need for trade in the inputs for the phosphate industry, while in chapter 6 the scope for the production of one ammonia product and import of others was observed. Trade of this nature may be limited by transport costs in some circumstances, but it should not be inhibited by strategic considerations since it need not involve those commodities which are crucial to national survival except where mineral endowments preclude self-sufficiency in them anyway.

188. Finally, fertilizer must not be seen in a vacuum. Although a strategic product in a region which desperately needs food, it is not the only such commodity, and economic considerations may make one-way trade in fertilizer between a pair of countries more appropriate than mutual exchange. A country such as India, for example, with its well-developed heavy industrial sector, may find that beyond some level of fertilizer output its comparative advantage lies in the production of steel goods for export rather than in the relatively inefficient generation of a wide range of fertilizers - especially those for which it must import the raw materials anyway. The net foreign-exchange saving which would accrue from domestic self-sufficiency may prove to be much less than the revenue which could be earned in more economic investments. Similarly, countries such as Thailand could find it preferable to import their relatively small domestic needs and use both the

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amount of subregional nitrogen trade would be 0.3 million tons in 1980, rising towards 0.5 million tons in mid-decade. External trade would be nil.

194. The final two situations, outlined in table 25(b) and (c), are intentionally anti-trade in nature. Where each ASEAN country seeks self-sufficiency without surpluses some subregional trade and a net import of 0.1 million tons from beyond the subregion could still occur however, unless the smaller countries settled for small-scale plants to match their markets. If only full-sized plants are considered, a determined drive for national self-sufficiency would yield surpluses in all countries, especially Malaysia and Thailand in 1980 (about 0.15 million tons each), and especially Indonesia and the Philippines in 1985 (about 0.25 and 0.15 respectively). Obviously no intra-regional trade would occur, but exports beyond the group would be significant provided that markets could be found elsewhere and the surplus product supplied at competitive prices.

195. The difficulties which could be encountered in such a situation could be avoided through the adoption of subregional trade as an explicit component of each country's fertilizer programme. There may prove to be a strong case for Thailand and the Philippines to concentrate on potash and phosphates respectively, relying on Indonesia and Malaysia for their supplies of nitrogen, whether in the form of ammonia, urea, other basic products or compounds. The possible role of an export industry in Singapore is more difficult to guage at this stage, since it depends on the alternative-use value of by-products of the island republic's considerable oil refining capacity. However the production pattern suggested here for the other four countries provides scope for export beyond as well as trade within the sub-region. There should be strong demand for phosphates and potash outside the subregion, and there is a possibility of limited export of nitrogen to India provided low costs are achieved through the ready availability of natural gas in Indonesia and also perhaps in Malaysia. Insofar as a trade pattern such as this may be desirable, it will be necessary for production plans to be designed around it, with careful evaluation of the costs of all alternative projects. The nature of the subregional co-operation which may be necessary to achieve this in ASEAN and other possible subregional groupings is considered in the following chapter.

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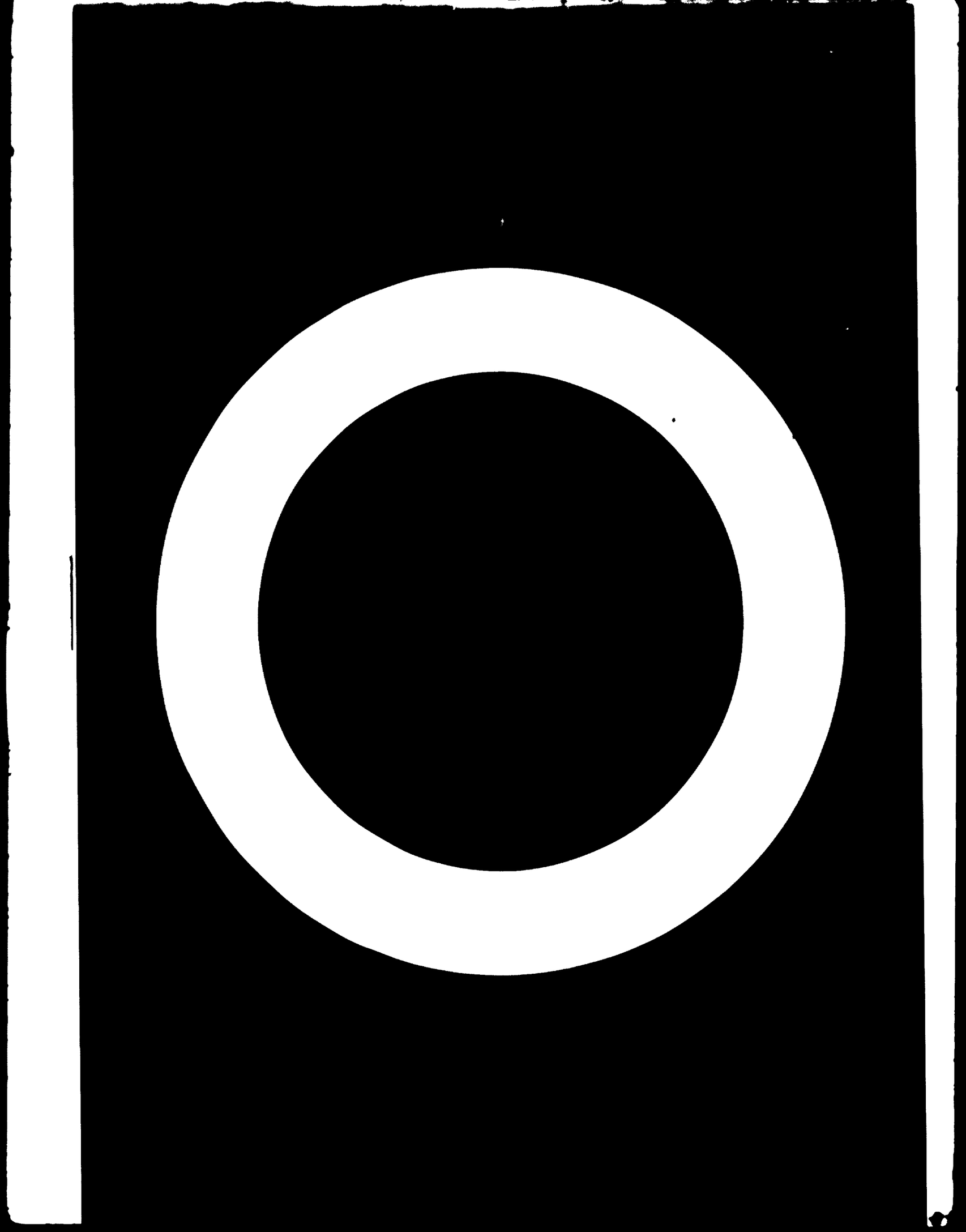

Chapter 9: Subregional Economic Co-operation

196. The central theme of the UNIDO/ESCAP project from which this paper arises is the indication of possible approaches to the expansion of fertilizer production and distribution which involve industrial and other forms of co-operation among countries of the ESCAP region or subgroupings within it. This chapter reviews current approaches to inter-country economic co-operation in fertilizer within the ESCAP region. It then outlines the argument for specialization and planned for expanded trade to be planned in advance on a regional or subregional basis in order to ensure the optimum allocation of resources to fertilizer production in each country. Finally, various ways in which further co-operation in production and trade among groups of countries might be achieved are described in support of later recommendations concerning the mechanics and initiation of co-operation, particularly in order to promote the development of some fertilizer export industries. Following the practice of the preceding two chapters, some of the discussion is expressed in terms of the ASEAN group, since the more detailed treatment of its supply/demand balance situation and trade potential permits a more comprehensive focus on this subregion. This emphasis here does not imply lack of scope for intercountry co-operation in other parts of the ESCAP region, however.

Current Progress

197. At the present time political constraints on co-operation are still of considerable importance, due to the uncertain external relationships, internal tensions and traditional attitudes which continue to characterise several parts of the region. Nevertheless, the advantages of specialization and large scale production and other internal economic considerations are providing increasingly important reasons for the small nations of South and Pacific Asia to develop a more integrated economy. If it is the primacy of "nation-building" as a policy which has been largely responsible for inhibiting previous attempts at regional co-operation generated by political ideas not consistent with this nation-building, then perhaps the current swing towards economic regionalism, fueled principally by economic needs, will stand more chance of success.

198. Furthermore, the development of the ASEAN grouping, though slow in terms of positive action, is becoming stronger and more comprehensive, thus providing at least a focus and a forum for the implementation of co-operative projects. The

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cessation of hostilities and changes of government in Indochina also may have created an environment more congenial to regionalism in Southeast Asia - or at least one in which economic schemes of mutual benefit have a chance of implementation. And although there is little except declarations of intent to show for the moves towards regional co-operation yet, both officials responsible for carrying on the many formal dialogues and Southeast Asian businessmen increasingly doing business outside their own countries are coming to feel more at home with commercial relations across national boundaries - and perhaps not a little frustrated by their own lack of achievement. The present year may see a marked change in the pace of progress in view of the importance accorded to economic co-operation in the first ASEAN Summit Meeting in February.

199. Several previous studies have indicated the net benefits of subregional integration in the ASEAN fertilizer industry.[1/] Recently the issue has received serious consideration within ASEAN itself, as evidenced by its inclusion in the deliberations of the Permanent Committee on Industry, the establishment of an Action Group on Fertilizers and Pesticides chaired by Thailand, a strong recent call for subregional co-operation in fertilizer by the Philippines Secretary of Agriculture. Moreover the potential for ASEAN collaboration in fertilizer is the subject of a current World Bank study by TVA's International Fertilizer Development Centre and the IBRD's Fertilizer Unit and Development Research Centre, and has been selected as a case for special consideration in the UNIDO/ESCAP project on which the present paper reports.

200. Of these indications, the most action-oriented so far occurred at the May 1975 meeting convened by ESCAP to discuss possible action among countries included in the Asian Industrial Survey for Regional Co-operation. This featured private sector initiation of positive measures which may result in practical ASEAN communities in steel and also, perhaps, fertilizer. In the case of the latter, note was taken of the present UNIDO/ESCAP project, and scope for co-operation was identified along five lines: (i) harmonization of national plans and establishment of plants to serve the regional market; (ii) co-operation in trade in final products (e.g. urea) and semi-finished products (e.g. ammonia, phosphoric acid); (iii) establishment of a project data bank, association of fertilizer producers and/or a fertilizer centre; (iv) establishment of joint ventures; and (v) long-term trade agreements. Thailand agreed to initiate the organization of the Action Group on Fertilizer and Pesticides which, it was hoped, would in

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1/ Notably the UN Team's Report, Economic Co-operation for ASEAN, under the direction of G. Kansu, presented to the ASEAN Advisory Committee and Permanent Committee on Commerce and Industry in July 1972, and the Asian Industrial Survey for Regional Co-operation, AIDC(9)/1, New York 1973, under the direction of H.C. Bos.

time assume the scope of a community.

201. Apart from this general approach in Southeast Asia, several examples of co-operation in fertilizer development are already occuring or incipient among developing ESCAP countries. These include five bilateral arrangements, four of which involve India:

(i) co-operation between the Philippines and Indonesia involving specialization in phosphates and nitrogenous fertilizers or inputs;

(ii) co-operation between India and Bangladesh in the transformation of the latter's gas into fertilizer;

(iii) India's involvement in the fertilizer project of Sri Lanka, consisting of a tied loan for the procurement of equipment and off-site facilities for the ammonia/urea complex now being established in Sri Lanka;

(iv) co-operation between Iran and India, with Iran providing a tied loan for the construction of iron ore agglomerating facilities enabling India to export iron ore to Iran in a specified form and to import a number of items which may include fertilizers; and

(v) India's provision of assistance to the Philippines for carrying out a feasibility study on an oil-based fertilizer unit being considered by the Philippines.

The last-mentioned is basically an example of technical assistance rather than economic co-operation, but the other four involve the expansion of markets through specialization and exchange.

202. In the first case, preliminary discussions have been held by the Governments of the Philippines and Indonesia on the possibility of exchanging excess supplies of either naphtha, anhydrous ammonia or nitrogenous fertilizers from Indonesia in return for either phosphoric acid made from by-product sulphuric acid or the latter itself recovered from copper smelting operation in the Philippines. Aside from many questions that need further clarification on this possibility, the two governments will not be able to start actual negotiation of a long-term supply/purchase contract until both can predict the magnitude of the excess supplies available for export. The domestic picture in both Indonesia and the Philippines of fertilizer supply-demand balances and prices could change substantially because of changes in official policies, while changes in the international fertilizer and capital markets could cause the postponement of both the fertilizer expansion and copper smelting programmes.

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203. The governments of Bangladesh and India have come to agreement on the desirability of mutual co-operation between the two countries, and plans for Indian participation as both investor and main customer of a new Bangladesh fertilizer plant utilizing large reserves of natural gas were quite advanced before talks were halted. Although the proposed arrangement should ensure a stable supply of relatively low-cost nitrogenous fertilizers to India, no progress has occurred on the feasibility study as a result of political changes in Bangladesh and changed fertilizer supply-demand situation both in India and in the rest of the world. It may be some time before the intergovernmental talks on the project are resumed.

204. Meanwhile however, India is involved in the installation of an ammonia/urea complex in Sri Lanka, by providing loans tied to the procurement in India of some portions of the plant and equipment and off-site facilities in return for the supply of nitrogenous fertilizers over the first few years after the plant comes on production stream. With the participation of the Government of the Federal Republic of Germany, the ADB, and the Kuwait Development Fund, the bilateral co-operative scheme is now expected to face fewer difficulties in the future.

205. The bilateral agreement reached last year between India and Iran presents an interesting example for any two or more countries concerned to exchange fertilizers for other unrelated commodities. According to the agreement, Iran is providing a low-cost governmental loan which enables India to install facilities to agglomerate iron ore for export to Iran. In return for this import, Iran will export a number of petrochemical and other products including fertilizers. While this bilateral agreement does not contribute to any increases in the capacity for fertilizer production, it assures a fertilizer exporting country of a stable market while ensuring a stable supply for the loan recipient, over a specified period of time. Arrangements of this kind seems to be quite suitable to the relationship between developed countries or oil-exporting countries with sufficient foreign exchange reserves and any developing countries with raw materials surplus for export. The

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arrangement essentially involves a long-term supply/purchase contract with firm commitments on both sides on a barter basis. The provision of long-term, low-cost government loans by one country to another has made it easier for the loan recipient to enter the agreement.

206. These four examples of economic co-operation in chemical fertilizer production and distribution among pairs of ESCAP developing countries indicate clearly that (i) these benefits accruing from any regional co-operative scheme must be mutual to the parties concerned and sound economically, which are the necessary conditions of any successful co-operative scheme, (ii) a strong political will is an essential prerequisite to successful co-operation among countries, however economically sound it may be; and (iii) regional co-operation could probably be best promoted initially on a bilateral rather than on a multilateral basis, which will minimize possible economic and political complications among countries.

Basis for Specialization

207. The two leading elements in the basis and nature of specialization in chemical fertilizers are the endowment pattern of basic raw materials and the economies of scale. Both have important cost implications, and the former may impose absolute technical constraints as well, which is why it underlies to a very considerable extent the developing ESCAP countries' supply-demand balances and opportunities for intra-regional or external trade discussed in this paper. As noted in chapter 5, potash deposits appear to be limited to Thailand and Laos, which could specialize in the manufacture of potassium fertilizers or intermediates and become major regional suppliers in the medium term. For nitrogenous and phosphatic fertilizers, and compounds containing them, the regional endowment pattern is more complex.

208. Fairly abundant hydrocarbon feedstock endowments make several countries in the region potential producers of nitrogenous fertilizers, mainly in the form of urea, for neighbours' markets as well as their own consumption. In particular, substantial gas reserves give Iran, Indonesia and also Pakistan a comparative advantage which provides a case for their establishing major regional nitrogen industries.

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Bangladesh, Burma, Afghanistan, Brunei and perhaps Malaysia also appear to have gas well in excess of their domestic needs, at least in the short-to-medium term; and these countries, especially Bangladesh, may wish to construct export industries too. Alternatively, they could consider exporting gas as LNG to producers elsewhere, as Brunei is already doing. At least four other ESCAP countries - China, India, Thailand and Malaysia - have gas but perhaps not enough to contemplate significant export surpluses of the ammonia or urea which may be produced with it. Similarly countries with alternative nitrogen feedstocks such as coal, naphtha and fuel oil are not likely to be able to export economically, except where low freight costs and security considerations prevail.

209. In contrast to the nitrogen situation, there are only three parts of the region where the basic raw materials for phosphatic fertilizers seem likely to be brought together: (i) the Philippines, which will probably still need to import rock to complement its own deposits and the sulphuric acid which it expects to derive from copper smelting; (b) China/North Viet-Nam/North Korea/Mongolia which may continue to co-operate among themselves; and (c) Australia which has already been producing phosphates on the basis of Christmas/Nauru/Ocean Islands deposits prior to development of its own Queensland deposits, but which lacks cheap sulphuric acid and is geared mainly for the manufacture of single superphosphate rather than the concentrated products preferred in Asian markets. Other countries with some ore, such as Iran and India, are likely to remain net importers. It would appear that the Philippines will have limited quantities of phosphatic fertilizer available for export, while Australia (or its present island suppliers) will be ready to supply large quantities of rock.[1/]

/210.

1/ Australian Government: The Prospects of an Australian Fertilizer Export Market, 1975, mimeo. script with slides.

210. The basic pattern of indigenous raw materials and feedstocks does not necessarily imply that trade would be in the finished products derived from them. It may be preferable to export the feedstocks in raw form (e.g. LNG, phosphate rock), or to process them for export in intermediate form (e.g. ammonia, phosphoric acid, mono-ammonium phosphate, ammonium sulphate). The recipient country could then convert such intermediates into simple products such as ammonium nitrate, calcium ammonium nitrate or triple superphosphate), or into compound fertilizers (e.g. diammonium phosphate or NPK mixtures), or used for other industrial purposes.

211. Where transport costs are not prohibitive, it may pay for the recipient to trade such final products in exchange for intermediate or raw material inputs associated with them. This is more likely to occur in the case of compound products based on several raw materials, only one of which may be indigenous to the final producer. But economies of scale could make it efficient even in the cases of single feedstock or simple fertilizers, or of compounds for which all chemical inputs must be imported. This pattern has dominated the industry in the past, and in spite of its erosion as a result of raw materials price rises, there will continue to be advantages for locating some processes at industrialized points away from their feedstock sources or markets - or perhaps both.

212. Economies of scale have been frequently overlooked as an important basis for specialization other than the distribution of raw material reserves, perhaps because fertilizer technology has been developed mainly for large countries which need large plants anyway. Increasing use of urea means that many domestic markets can support at least one large 1,000/1,667 ton/day ammonia/urea complex producing annually more than 200,000 tons N. However, those developing ESCAP domestic markets which will not do so by 1980 include Thailand, Malaysia, North Viet-Nam, Laos, Cambodia, Burma, Sri Lanka, Nepal, Afghanistan and perhaps even Bangladesh. Of these, Burma is now planning to add a relatively small 500 tons/day urea plant (yielding annually about 60,000 tons N, while Sri Lanka will at least find some economies of scale by selling India part of the output of a half-sized nitrogen complex. These two small plants (and those which China is building in preference to large plants on the grounds of internal transport bottlenecks) may provide evidence of the ability of such scales to compete with larger plants.

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213. However, the apparently large unit savings gained in larger facilities has been pointed out in chapter 7 above, where it was shown also that even the large 1,000/1,667 ton/day ammonia-urea facilities suffer a 20 per cent cost disadvantage compared with 1,500/2,500 ton giants. Thus it would pay countries which need less than 200,000 tons N/year each to group together and elect one of their number as the site of a joint ammonia/urea venture. This could be built and operated at an optimum scale to serve the expanded market and provide security of supply to each participating country. Alternatively small countries could associate themselves with larger entities in arrangements under which the ammonia and urea were produced in the appropriate locations considering the feedstock source and the main market, with resulting trade being balanced in other ways.

214. Scale economies are even more likely to be significant in the case of fertilizer products (such as ammonium nitrate and the many NP and NPK compounds) for which domestic demand is much smaller than that for urea. Unless these can be produced in association with other chemical industries, or readily derived from imported intermediates, few countries may find their manufacture worth undertaking. The several small, inefficient plants already operating in ESCAP region provide good examples of this situation. For these products even the security argument may not imply domestic production, since they form but a small proportion of fertilizer requirements. However, there may well be scope for their preparation within the region, either close to ammonia and/or phosphoric acid facilities or at a location from which a subregional market can be served effectively.

215. To take the case of ASEAN as an example once again, a possible pattern of production and trade on the basis of subregional economic co-operation could consist of the following. The three Indonesian nitrogen complexes not already firmly planned or under construction might be suspended for consideration along with the two or three other plants which might otherwise be located elsewhere in the subregion. Of the six plants which would then be under consideration, only three or four would be constructed as "ASEAN plants", in locations determined by consultation on the basis of economic criteria including feedstock, transport and market considerations. With medium demand four plants would yield an ASEAN surplus of about 0.3 million tons N in 1985, much less than the excess production if each country proceeded independently, while the three-plant variation would yield a reasonably small surplus and therefore would be preferable unless higher subregional demand or available export markets were envisaged.

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216. This solution would be preferred from several points of view. It would feature planned self-sufficiency for Indonesia before the additional three or four new "ASEAN" plants were taken into account. It would ensure also that those of the additional plants which are located in Indonesia (or elsewhere, for that matter) would have a guaranteed market within the subregion to enable them to be constructed at an optimum size and to be fully utilized. Meanwhile the Philippines, Malaysia and Thailand, while not self-sufficient apart from the new ASEAN plants, would have guaranteed supplies from them. These three countries also would have the knowledge that the plants' number and location would have been determined in an ASEAN consultation whose aim would be maximum efficiency and minimum delivered prices for each participant. Another crucial consideration, referred to already, might be the desirability of the Philippines and Thailand specializing in phosphates and potash respectively, and exchanging these for gas-based nitrogenous products from Indonesia and/or Malaysia.

217. In practice, subregional consultation and harmonized investment planning might yield a production pattern for nitrogen similar to that which would occur in a free market without the "strategic commodity" problem, depending on the weights which relative costs would attribute to feedstock, transport and market factors. For example, its endowment of gas and experience in the industry may retain three of the ASEAN plants in Indonesia. Alternatively, transport and market considerations might place a plant in each of the Philippines and mainland Southeast Asia (e.g. Songkhla), or even two plants in one of these areas (e.g. Songkhla and Singapore, or two sites in the Philippines). Sarawak might be another possible location for one of the ASEAN nitrogen plants, especially if the Philippines and Thailand were concentrating on other fertilizers. Indeed, if gas availability were the determining consideration, the optimum pattern might place two plants in Indonesia and one each in Sarawak and possibly Songkhla. Alternatively, if the potential disadvantage of using naphtha as a feedstock could be offset, even Singapore might be a desirable location from an ASEAN point of view, especially for a fourth or a fifth plant to meet subregional imbalances and to export outside ASEAN.

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218. As these several alternatives indicate, more detailed studies are required to determine the optimum distribution of the various fertilizer facilities which the subregion should bring on-stream in the early 1980s. Present indications of the benefits which integration would yield justify the allocation of resources to such studies before further investment commitments are made by any ASEAN member. Among the particular aspects which need careful assessment are:

(i) the growth and pattern of demand by fertilizer product in each consuming country;

(ii) the scope for export beyond the subregion of excess product or intermediate;

(iii) the likely competition from imports from non-ASEAN countries with marginally-priced surpluses (such as Bangladesh, Burma or Japan) and/or low-cost over-all operations (such as Iran, other Middle East oil and gas producers, or Japan again);

(iv) the amount and alternative-use value of each feedstock and raw material available within ASEAN;

(v) the opportunity cost of applying the very large amounts of capital involved to attaining even sub-regional self-sufficiency in fertilizer; and

(vi) the relative cost and availability of transport within the subregion.

Some consideration of issues such as these will be included in the study now being conducted for the World Bank, the major source of external finance for new production facilities, but action needs also to be undertaken by the ASEAN governments which will be making the decisions on whether and to what extent to co-operate in this key industry.

Techniques of Co-operation

219. Once the basis for specialization and consequent exchange is established, choices may be made among the many different possible approaches towards the stimulation and organization of regional or subregional economic co-operation. The following may be of interest in the field of fertilizer production and trade:

(i) a formal and comprehensive intergovernmental arrangement among a recognized or *ad hoc* group of countries;

(ii) a less formal arrangement, with co-operation stemming mainly from a subregional view being taken by financial or entrepreneurial groups involved in the industry;

(iii) informal or non-comprehensive intergovernmental arrangements concerned with particular aspects of the industry; and

(iv) some mixture of the above three approaches, especially in the light of the ability of the second to follow from the first or to be conducted in conjunction with the third.

The first is discussed in the present section, while the other three are considered later as "alternative approaches".

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220. A formal and comprehensive intergovernmental arrangement to harmonize planning might have all new production facilities planned and constructed on a group basis, with locations within each subregion determined on economic criteria. This collective security approach includes joint evaluation of probable demand, free trade in fertilizer inputs and products among countries in the subregion, harmonized investment and co-operative supervision of plant operation, distribution and marketing. A consultative committee might be appropriate to direct collective forward planning and investigation, especially with respect to feedstock supplies, process technology, product requirements, probable demand and plant location possibilities. This group would produce a series of schemes prescribing the location of new plants and consequential mechanisms for consideration and adoption by the member governments.

221. A free trade agreement would be necessary to enable supplies of inputs and fertilizer products to cross national frontiers without penalty, while forward purchase and supply contracts between pairs of countries in the subgroup would guarantee demand for and availability of the plants' offtake. Financial co-operation would include arrangements to make both subregional and external capital available for the construction of plants designed to serve the subregional market; and co-operative shipping and/or land transport arrangements would ensure low-cost freight. Finally, technology exchange arrangements would pool subregional expertise and experience to ensure maximum efficiency in plant planning, construction, operation and marketing.

222. These and other mechanisms necessary to implement successful plan harmonization might be established separately, or perhaps within the contexts of similar arrangements covering other industries. In the absence of a "package approach" to industrial co-operation however, and in a milieu where the use of purely economic criteria would be difficult to ensure for each separate mechanism (thus yielding automatic co-ordination between them), the member governments may prefer to establish some form of subregional Fertilizer Authority to co-ordinate all aspects of the arrangement. Such an agency could also assist the subregion meet its fertilizer needs efficiently through a wide range of related activities which would be desirable even in the absence of a plan harmonization programme itself. These might include, for example:

(i) research;

(ii) acquisition from abroad of inputs, technology, etc., and of these fertilizer requirements still not produced within the subregion;

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(iii) technical assistance to members countries in distribution, promotion, marketing and farm-utilization, and in the efficient operation of existing plants;

(iv) monitoring of world price and supply trends; and

(v) the exploration and development of indigenous raw materials and appropriate technologies.

Each of these activities is urgently required on a regional or subregional basis, and in the absence of subregional economic arrangements they could be performed by ad hoc arrangements to co-operate in economic information services and technical assistance, or by the Regional Fertilizer Development Programme recommended in Part D below.

223. As far as the plan harmonization programme itself is concerned, the experience of subregional co-operation schemes elsewhere suggests that the most difficult issues to resolve are likely to be those concerning plant location and planned trade. Economic criteria to determine the former are not difficult to identify,[1/] although their quantification may be complicated in an environment of subsidies, protective devices and underdeveloped financial markets. More substantial difficulties are likely to stem from: (i) countries' unwillingness to rely on the rest of the arrangement working to assure them of secure supplies not produced within their own frontiers; (ii) the problem of evaluating the external economies (and diseconomies) of plant operation; and (iii) uncertainty about the economic and, perhaps more important, institutional factors involved in alternative use of natural resources and capital. Planned trade shares with plant location the first of these three problems and also involves difficult decisions about (iv) the appropriate penalties for non-supply or non-purchase, and (v) the relationship of planned prices to ruling world prices which would not be known at the time the arrangement was made.

224. The first problem to be dealt with in establishing a subregional specialization and exchange scheme concerns the extent to which participating countries could rely upon it to provide the security of supply at reasonable prices which they require. However much the scheme might be more efficient than a national self-sufficiency approach, it would not be countenanced seriously if

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1/ See, for example, the discussions on raw materials endowment and production economics in Part B (chapters 5 and 6) above, as well as the preceding section.

it could not guarantee greater security than continued reliance on world markets. Moreover, because of the long gestation period involved in establishing fertilizer facilities, a breakdown in a supply arrangement would leave a country dependent on external supplies for several years before domestic or alternative subregional facilities could be established. If such a break occurred at a time of high world prices or limited supplies, food production could fall to levels which implied mass starvation and/or national bankruptcy. On the other hand, a failure by a producer's neighbours to purchase planned quantities, especially at a time of world glut, could impose heavy costs on the plant(s) concerned.

225. To avoid such situations, a country agreeing to rely on supplies from a neighbour would need to be reasonably certain that production and planned trade would not be disrupted by changes of political orientation, major errors with respect to feedstock source or plant operation, or unilateral responses to changes in relative or world prices. Repudiation of either sale or purchase contracts would need to be rendered extremely unlikely, both by the terms of the intercountry arrangement and by the degree of trust among its participants. In the cases of democracies, and dictatorships in which the regimes may change in the interim, these decisions need to be taken on a broad political front lest a new government seek political capital or deal with changed circumstances through repudiation or unilateral adjustment, rather than through reasonable renegotiation within the context of the arrangement. Not unreasonably, one country will hesitate to participate if it cannot be fairly certain that each partner will honour the agreement, including its penalty provisions.

226. Evaluation of and compensation for external economies and diseconomies of plant establishment and operation has often proved to be a significant impediment to industrial co-operation. The "package approach", whereby each country specializes in one or another industry, has the advantage of broadening the basis for a rough balance among the participants with respect to those factors which difficulty of assessment renders hard to compensate through the pricing or other mechanisms. Nevertheless, one important reason why the chemical fertilizer industry may be a good candidate for the early stages of non-package subregional co-operation is its capital intensity and use of modern technology. Since its employment and technology-transfer effects are less significant than those of other industries, the fertilizer industry can be developed more specifically for the purpose of supplying large quantities of nitrogen and other nutrients to Asian farms at least-cost. In so far as least-cost may imply external production and import, the sacrifice of domestic industrialization may be well worth making.

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227. It may not be necessary to make such a sacrifice in practice however, since the use of economic criteria is quite likely to place at least mixing and granulation plants in countries which do not contain the giant units producing either ammonia and urea or phosphoric acid. Furthermore, the distribution of natural resources in some subregions is such that a rought balance of industrial activity may occur anyway in the pursuit of economic specialization, without the need for complicated compensating adjustments. The example of ASEAN which has been used in this paper illustrated such a balance, there being natural gas in Indonesia and also Malaysia and to a lesser extent Thailand, sulphuric acid capacity and some phosphate ore in the Philippines, and carnellite for potash development in Thailand's northeast provinces.

228. The third difficulty likely to complicate joint decisions about plant location concerns uncertainty about a country's alternative uses of the financial and natural resources which would be allocated to a plant if it were sited in that country. This uncertainty inhibits the assessment of the opportunity costs of producing fertilizer - an intercountry comparison of which should form the key economic determinant of optimal plant location. Moreover its resolution with respect to one type of resource may still leave doubt about the other, since different and broader considerations may be necessary for capital than for feedstock exploitation. In both cases, however, predictions are required of the relative prices of feedstock, fertilizer, food, other agricultural requisites and other industrial products. The likely efficiency of domestic production in each resource-use also must be assessed honestly if suboptimal investment decisions are to be avoided and the benefits of international trade obtained on behalf of indigeneous consumers, farmers and industrial workers.

229. An important but often understated consideration affecting the economics of these investment and resource-use decisions in developing countries is the institutional capacity to pursue various courses. For example, a large gas deposit may be better liquified for export if this involves less complicated technology and infrastructure than fertilizer production in an undeveloped location. It may be preferable in such a case to cash the reserves directly and to allocate scarce capital to other industries - even to the import of food or fertilizer. Alternatively, the self-contained nature of a fertilizer plant may make it a better bet in such a location than other gas-based industries with more horizontal or vertical industrial linkages. Meanwhile it may prove economic to establish a fertilizer facility in another location with more highly developed infrastructure and a modern commercial institutional framework, in spite of relatively high feedstock costs prevailing there. The proposed naphtha-based plants in Singapore and the Republic of Korea could represent this situation.

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230. Penalty clauses form a difficult but essential aspect of any planned trade contract. Since faults or elements of unacceptability and injustice in them may disrupt the trade arrangement -- and thus jeopardise the whole basis for the specialization pact which the parties will have committed themselves several years earlier -- it is essential that the principles underlying them are clearly understood and accepted in advance. The purpose of penalty provisions is to allow one party to depart from the strict terms of the arrangement without causing undue distress to its partners. In a field where future prices, requirements and other factors are very difficult to project accurately, such departures may be highly desirable from a subregional as well as one country's point of view. However the penalties must be designed so that compensation provisions deter selfish departures while spreading the benefits of desirable ones in order to protect investments made in good faith to serve the subregional interest.

231. One can imagine a situation, for example, where a sharp fall in world prices might make production at a subregional plant located in one country temporarily uneconomic. With appropriate provisions in the contract, a decision to reduce output could be taken in the same way that it would be in a national plant -- i.e. by comparing the unit savings made by importing with the overhead-cost losses caused by the shut-down -- since the losers and gainers would be all participating countries. In the opposite situation where a consuming country wishes to reduce its purchase, the penalty it should pay to the host country for non-purchase should approximate its "share" of any losses caused thereby. The cost of this penalty would then be evaluated as part of the decision to renegue. Naturally, all such changes should occur through consultations to ensure mutual benefits, emulating as closely as possible the ideal of the subregionally-owned and operated plant, where the participating countries would have an investor's interest in the good performance of the operation.

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232. The sort of difficulties alluded to above should be minimized through the inclusion in the subregional arrangement of a price setting and adjustment mechanism capable of maintaining equitable and economic production, supply and purchase levels in the face of changing circumstances. However both the development and the operation of an appropriate pricing mechanism would be fraught with dissension unless the participating countries were genuinely interested in adopting a subregional approach to the industry (rather than merely seeking recourse to it to deal with a temporary emergency or to capture gains at the expense of other participants). The difficulty of finding the right prices for planned trade over time stems from the considerable number of variables which would affect them, including changes in, for example: feedstock prices if imported or alternate-use values if indigeneous; labour, maintenance, spares, power and other process costs; transport costs; and world prices for competitive products. Any of these may change at various rates as a result of inflation, macro-economic policy measures and other exogeneous factors.

233. The combined effect of such changes on the actual delivered cost of output might be considerable, facing the participants with several dilemmas. Chief among these if the arrangement lets the market find the right price might be whether to allow the quantity demanded or supplied to vary or else to maintain fixed quantities at full capacity-utilization and share the cost finding so among the participants. Alternatively, if formula prices are used to avoid fluctuations and maintain high utilization rates, possible plant losses or costs to purchasers in excess of world prices may need to be allocated among the participants in an equitable manner.

Alternative Approaches

234. Apart from full-scale plan-harmonization, a possible approach to subregional economic co-operation is its stimulation by financial or entrepreneurial groups. Even if the seriousness of the fertilizer supply situation, the huge capital investment involved, the difficulty of projecting demand and the risk of unsaleable surpluses are not sufficient incentives for governments to take the initiative, they at least might take steps to allow or encourage market forces and semi-official institutions to make rational allocative decisions from a subregional point of view. The stimulus may stem from any of the

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following groups, whose judgement of optimal locations, plant-sizes, product specialization, etc. is reflected in their project selection:

(i) foreign private investors including multinational fertilizer enterprises;

(ii) external financial sources such as the international and regional development banks, perhaps in co-operation with each other;

(iii) private sector entrepreneurs in the subregion; or

(iv) public agencies or corporations in the subregion.

This subregional view may be more or less explicit, depending on the need for formal collaboration in order to derive market information. However, it need not be shared by governments to the extent of being reflected in commercial legislation, and any trade would occur because it was worth-while in spite of official barriers to imports or subsidies to domestic production.

235. Foreign private investors may be expected to take an objective subregional stance which can be shared less easily by nationals or fertilizer countries in a subgroup. Indeed, in the absence of national policies to distort the market, private capital from extra-subregional sources, anxious to ensure high profitability, would shun investment in plants with suboptimal scales, high-cost feedstocks or low prospects of disposing of all of their output at high utilization rates. Especially after the fluctuations which investment and production have sustained in the world fertilizer industry over the past decade, international investors in it can be expected to adopt a cautious approach towards plant location, and perhaps to welcome planned trade. The latter would be conducted through private sector arrangements if governments did not participate officially.

236. The same cannot necessarily be said of official external financial sources, especially developed donor countries which sometimes let strategic considerations affect their development assistance efforts. However institutional lenders such as the World Bank Group have already indicated concern about the danger of over-supply and inefficient production. Thus external lending may also favour the establishment of subregional rather than national plants. Moreover, through their influence on recipient countries' economic policies, they may encourage direct intergovernmental co-operation as well. Being regional institutions, agencies such as the Asian Development Bank are likely to exhibit a bias towards co-operation rather than autarchy, and selectivity in their lending and other support for new fertilizer facilities should be based on subregional market considerations. At the very least, these various institutions are in a better position than individual countries

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to take into account likely world price and supply trends, and particularly production and potential trade patterns with respect to surrounding countries.

237. A third possible influence to encourage a subregional approach to fertilizer investment may come from the private sectors of participating countries. Increasingly, for example, businessmen in Southeast Asia (particularly those with access to sufficient funds to contemplate participation in fertilizer complexes) are exhibiting comprehension of the advantages of co-operation through specialization and trade. Cultural factors, infrastructural difficulties and explicit anti-trade government policies have inhibited the realization of subregional schemes in the past, but by the early 1980s many businessmen should have overcome these constraints and developed strong commercial links among ASEAN countries. These will tend to encourage subregional investment where economic considerations dictate and official policies permit. In South Asia, too, there may be scope for increasing cooperation among private fertilizer entrepreneurs, although this will be constrained by the public sector's substantial role in national industries.

238. Finally, there is the possibility of co-operation stimulated and perhaps practised by quasi-public institutions in the countries of the subregion. Development banks, boards of investment, petroleum agencies (such as Pertamina in Indonesia or Petronas in Malaysia), energy authorities, and perhaps rural institutions concerned to deliver cheap fertilizer to farmers, can be expected to consider subregional and broader approaches to fertilizer investment, production and distribution. Even without formal intergovernmental support, such authorities should consider subregional sources of finance and potential markets when they are involved in domestic investment decisions. They may go further and, through co-operation with their counterparts elsewhere, act as vehicles for investment in facilities beyond their individual countries. One logical consequence of this process could be the application of the "ASEAN Multinational Corporation" concept to the field of fertilizers. Public corporations appear to be the most likely basis of such a development although indigenous businessmen and foreign investors are also likely and desirable participants.

239. Co-operation stimulated by the various investment sources considered above could be supported by informal or non-comprehensive intergovernmental arrangements among subregional countries. Alternatively such arrangements themselves might comprise the dominant catalyst for broader and deeper harmonization. The arrangements could involve intercountry collaboration on economic analysis, production technology, stock management, raw materials development or other aspects of the fertilizer industry. Within such general but loose, or firm but specific, arrangements, each government would be better fitted to take account of its partners' production situations. While not influencing the latter directly, the government might adjust its own plans accordingly, and assist particular trade

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arrangements by reducing barriers. Although not yet widespread with respect to fertilizer in the subregions of ESCAP, some examples of ad hoc co-operation involving India and other countries were cited earlier in this chapter, while several recommendations for further specific inter-country programmes are made in Part D (especially chapter 10) below. Moreover, there appears to be scope for such contacts to be expanded greatly.

240. One basis for such expansion may be the technical experience which Indonesia, India and also Pakistan have gained in the establishment and operation of modern nitrogen plants in advance of their neighbours. Co-operative approaches may be helpful also in the acquisition and adaptation of appropriate technology for fertilizer production and distribution. It is well accepted that close monitoring should be maintained on developments occurring in such research institutions as TVA's International Fertilizer Development Centre and also in other countries and subregions of the ESCAP region where fertilizer production is more advanced. Co-operation among developing countries would facilitate this monitoring and the ready adaption of new technologies to Asian needs.

241. Second, the importance of sharing information on future export surpluses, and of working together to expand knowledge of world supply, demand and price trends, will soon be recognized by each government. Indeed, the establishment of improved fertilizer economic information services should be treated as a matter of urgency, at least in the case of ASEAN. This is necessary to ensure that data collection and analysis begin at once with a view to supplying governments, local businessmen and external investment sources with information on the subregion's fertilizer requirements, probable demand, production facilities, etc. as soon as early-1976. The services might include also research on alternative uses of raw materials endowments, to help governments make economic decisions about fertilizer or other industrial development.

242. Another particular aspect of the industry which lends itself to co-operation even without full-scale plan harmonization, is stock management and perhaps co-ordinated trade to clear markets. As well as ensuring safe storage and minimal spoilage within the subregion, such activities might extend to joint marketing of export of surplus subregional output to external buyers. As far as domestic markets are concerned, each country has accepted the urgent need to expand effective demand through the improvement of distribution for utilization among small farmers. Even in this internal matter governments of a subregion can benefit by the exchange of experience and other subregionally co-operative approaches to the investigation and solution of common problems.

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243. Co-operative efforts might be pursued in each of the above areas of activity separately. However links between them would be bound to occur, and even if these were not formal the experience of co-operation in the field should lead to more formal and comprehensive arrangements where these were found to be appropriate. Indeed, even if governments of a subregion felt there was already an a priori case for full-scale plan harmonization on fertilizer, an appropriate approach to its implementation might be the prior establishment of the mechanisms necessary for the individual co-operative efforts cited above. Their operation would soon provide most of the information base necessary for the intelligent design of a broad subregional approach to the industry.

244. Furthermore, if the mechanisms comprising this third approach did not lead to a full-scale intergovernment effort, each one might still promote the adoption of a subregional view beyond its own scope, and encourage the institutions referred to in the second, investor-oriented approach to lend their weight to the process. As a country's knowledge of its neighbours' situations and trends was expanded by each specific co-operative arrangement, it would be better able to take them into account in formulating its own plans. By a process of osmosis, the organization of the industry should become increasing rational and subregional in nature, even without formal intergovernmental harmonization.

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245. Thus some mixture of the three approaches is more likely to be both feasible and successful than any one alone. Unless governments embarked upon the exercise already convinced that full-scale intergovernmental harmonization of investment plans and plant operation was essential, a strategy combining the second and third approaches would form the next-best solution. This would entail two basic types of actions by each government:

(i) the removal of any obstacles which would prevent financial or entrepreneurial backers from taking subregional markets into account when selecting sites for production facilities; and

(ii) the vigorous pursuit of ad hoc collaboration among fertilizer agencies with respect to research and information, technical assistance, stock management, etc.

It is likely that any consequent co-operation at the fundamental level of planning would be better based on experience and rational resource allocation.

246. The discussion so far has implied a closed subregional market within which governments have the single option of co-operation or autarchy. Realistically, this assumption must be relaxed for the ideal package to combine economy with security may well include some extra-subregional trade, or even subregional trade beyond the scope of formal co-operative arrangements. Among the reasons for this are: the subregion's lack of sufficient quantities of some basic raw materials, at least in the short term; the likelihood that even with careful planning of supply and estimation of demand there will be temporary shortfalls or surpluses beyond the control of price cum-subsidy mechanisms; and the possibility of capturing cheap supplies on world markets at times of low prices.

247. It must be emphasized also that subregional arrangements alone represent a second-best solution, dictated by security rather than economic considerations, only less so than in the case of national autarchy. It is possible that they would merely formalize a pattern of production and trade with would occur in the absence of interference with market forces; but it is more likely that they would establish a sub-optimal pattern, preferable to autarchy but still influenced by political judgements or pessimistic forecasts of the impact of world trends. Whether they establish a new pattern, or merely lend an element of security to market-oriented developments, they should not preclude trade on a commercial basis with outside countries.

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248. Indeed, in the case of ASEAN, there may be scope for formal arrangements between external countries and the subgroup or some of its members, existing parallel to the subregional arrangement itself. A contract to supply part of India's long-run shortage, for example, might improve the economics of subregional plants, while either separately or in association with such a contract, India might supply technology, equipment or managerial assistance to the development of the ASEAN industry. India has already been involved in rendering services to the Philippines, perhaps forming a first example of co-operation with other developing countries. The imminent establishment of a National Fertilizer Development Centre in Pakistan indicates a further vehicle through which ASEAN might form associations with South Asian producers. Such developments do not preclude the establishment of fully regional institutions to provide the necessary framework for industrial development however, especially with respect to economic information. Nor do they remove the need for subregional economic co-operation to ensure that this development is as orderly and commercially sound as possible.

249. In conclusion, the main argument of this paper and especially of the present chapter may be stated as follows. In the absence of co-operation, developing ESCAP countries have two possible sources of chemical fertilizer: the world market and domestic production. In some cases the latter may be economically justified, and thus should occur without intervention. The recent crisis may have stimulated such production by focussing attention on economic opportunities unrealised hitherto, or else the economic basis for it may have emerged only as a result of recent raw materials developments within the region. In other cases domestic production may be justified in terms of security rather than economy, in which cases it is necessary for the countries concerned to be fully aware of the economic costs they may be incurring as the price of this security. These costs may stem from any of the several factors discussed in chapter 6, and would be incurred or increased if world developments in the industry were to make world prices (including transport) lower than local production costs in the future.

250. Subregional schemes to expand effective markets and ensure that comparative advantage is exploited may mitigate the cost, however, while at the same time maintaining a measure of the security that is sought by countries which fear reliance on the world market. Subregional approaches may be superior to national production by creating trade to exploit raw materials endowments, economies of scale,

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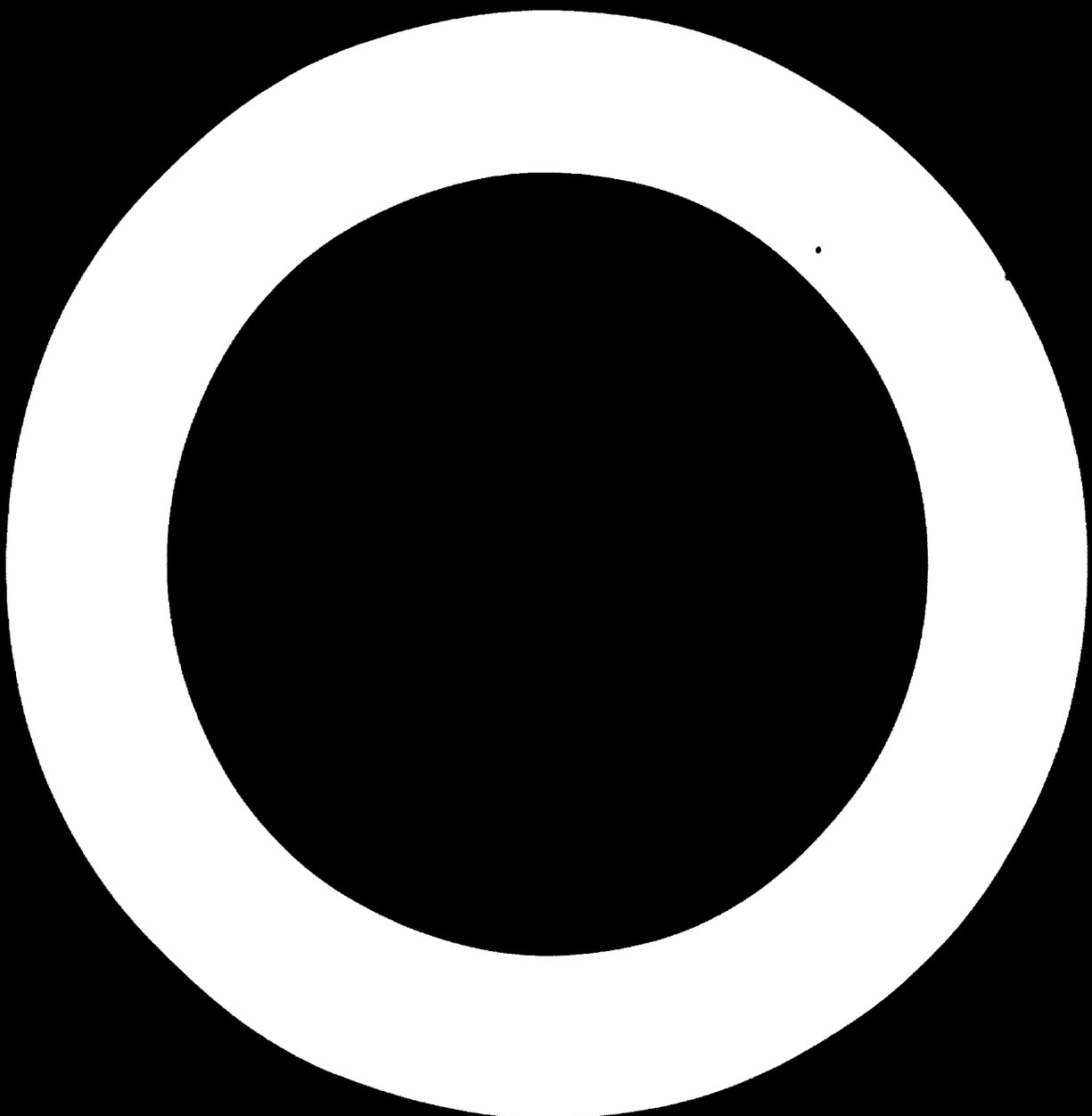
possibly lower transport costs, and the externalities which may be produced by the development of an industry which would not otherwise occur in some participating countries. Moreover, subregional groupings for the purposes of integrated fertilizer industry development are likely to be superior to a broader regional grouping for the same purpose, since the latter in the ESCAP region would suffer the effects of comprising a large number of culturally and politically diverse entities. On the other hand, even subregional schemes may be fraught with the difficulties and costly errors which have foiled or inhibited many similar attempts in the history of commodity arrangements. At both the subregional and regional levels, however, there is wide scope for other forms of co-operation to assist the development of national industries and otherwise help to secure supplies of fertilizer at prices which are appropriate in terms of benefit-cost ratios at the farm level.

251. Finally, even after a subregional integration approach has been costed and chosen, there remains an important choice to be made on its implementation. In view of the large public involvement in the industry already, government-to-government arrangements may be appropriate. Alternatively, market forces may be more effective and reliable, provided that governments take necessary steps to remove distortions and perhaps provide non-discriminatory protection on a subregional basis during the new industry's infancy. The cost of this protection would represent the amount the countries were prepared to pay for the greater security offered by subregional production compared with reliance on the world market. If the subregional approach has a firm economic basis, the cost would be likely to be lower than that which would be incurred to establish and protect purely national production facilities instead.

/PART D:



PART D: RECOMMENDATIONS

Chapter 10: Promotion of Economic Co-operation

Subregional Plan Harmonization and Trade

252. The advantages of co-operation among groups of countries with complementary interests in chemical fertilizers were outlined in the previous chapter. In summary, such complementarity may occur as a result of different resource endowments, markets too small to support production facilities of an economic size, different industrial specializations even within the chemical industry sector, or other reasons. In addition to its having an economic justification as being superior to attempts at national self-sufficiency, integration of the industry on a subregional basis may be considered superior to geographically broader arrangements or free trade. Inter alia, it enables each participating country to retain or achieve a measure of control over production of a range of strategic products which would otherwise be absent, and thus channel along economic lines the concern which developing ESCAP countries have felt as a result of fluctuations in the international fertilizer market. A subregional grouping in fertilizer may also reflect or further an existing commercial or political association of countries, thus gaining the advantage of reliability as part of a broader set of commitments.

253. Whether as part of a "package deal" approach to industrial integration, or as an industry singled out as an early and trend-setting example of such integration, the chemical fertilizer industry lends itself for close economic co-operation on a subregional basis. Since market distortions, long gestation periods, strong public interest in the industry, the need for security, and the huge amount of investment required, may inhibit such developments occurring without intergovernmental supervision, action by each potentially participating government will be necessary to launch and operate them. It is therefore recommended that groups of ESCAP member countries which include deficit and surplus producers of various chemical fertilizer nutrients and products should give serious consideration to the harmonization of fertilizer production planning and the arrangement of future trade on a subregional basis, with appropriate pricing provisions and incentives to reduce uncertainty and ensure benefit for all parties /Recommendation 1/. More formal and comprehensive schemes may be developed out of existing trading and other fertilizer relationships, or out of groupings of countries with broader purposes which may be served by the inclusion of integration of the fertilizer industry.

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254. It was also noted in the previous chapter that considerable progress in the rationalization of the industry in the ESCAP region could be achieved even in the absence of formal treaties. One important source of such progress could be the public and private investors in the new production facilities, anxious to ensure that the billions of dollars involved are not wasted as a result of uncoordinated action leading to suboptimal location and under-utilization. Among these investors are private foreign investors, international or regional development banks, and private or public sources of equity and loan capital within developing ESCAP countries. To assist this process, it is recommended that private and institutional foreign and domestic investors in fertilizer facilities in the ESCAP region should be encouraged to consider the opportunities and need for subregional (and external) trade in order to ensure rational allocation of capital and maximization of long-term profitability; and that subregional investment in production facilities should be promoted /Recommendation 2/. In order to have this come about, it may often be necessary for developing ESCAP governments to remove market distortions and discriminatory tax or tariff provisions, and to ensure an expanding market.

255. Another type of stimulus to subregional economic co-operation short of formal plan harmonization and fully organized trade may be the development on a broad scale of intergovernmental arrangements and joint-projects on various aspects of the chemical fertilizer industry. Some contacts of this sort have already commenced within the developing ESCAP region, but there is scope for their considerable expansion in such fields as economic analysis, production technology, raw materials development, stock management, price stabilization, marketing and fertilizer-use. It is recommended that ESCAP member governments should avail themselves of every opportunity to expand contacts with other countries, especially those with complementary chemical fertilizer prospects, by exchanging expertise and information and by making ad hoc subregional arrangements on particular issues such as stock management and market development /Recommendation 3/.

Regional Fertilizer Economic Information Services

256. It is evident from the demand and supply projections reported in chapters 3, 4 and 7 of this paper that there is a likelihood of surplus in nitrogenous fertilizer in the ESCAP region by 1980, but that a 10 per cent variation in output as a result of different rates of installation or utilization of capacity, or in consumption as a result of different growth rates of

/demand,

demand, could leave the region as a whole in deficit. However accurate the data on which the supply estimates and projections are based, there is a multiplicity of factors which can significantly hasten or retard the actual attainment of planned levels. The highly sophisticated nature of the technology now used in the manufacture of chemical fertilizers, the difficulty of planning the supply of equipment, and other factors often involving a number of countries and agencies may cause delays in spite of the use of critical path analysis and detailed monitoring of investment. On the other hand, the plants now being designed or constructed incorporate the latest developments in technology and reliability, and some may achieve higher operating rates sooner than past experience would suggest. In particular, the supply-demand balance of the whole 11-country group could be affected significantly by the speed with which high capacity-utilization is achieved in the two very large coal-based and several large fuel-based plants in India, some of them involving technologies not yet fully tested and proven.

257. As far as demand is concerned, forward estimates are subject to factors which are even more difficult to predict with a high degree of accuracy. Weather conditions, world production of food grains and cash crops, widespread pest attacks, breakthroughs in agricultural technology, and the various considerations discussed in Chapter 4 above are only some of the factors which could cause actual demand levels to deviate radically from expectations. Thus both supply and demand estimates can be regarded as no more than orders of magnitude. A combination of unpredictable factors can create a surplus or a shortage of fertilizer in a country which might reasonably have expected to achieve a supply-demand balance on the basis of a planned production programme.

258. The viability of a chemical fertilizer industry is highly sensitive to the assured availability of cheap raw materials on the one hand, and to its proximity to consuming areas in order to avoid high transportation costs on the other. It is advantageous to establish large-sized fertilizer plants in countries having comparative advantages with respect to raw materials availability and to have assured export markets for output in excess of effective domestic requirements. Among the 11 countries under consideration, at least Bangladesh, Indonesia and the Republic of Korea are planning the establishment of large capacities on the presumption of exporting a substantial portion of their output. These and other surplus producers in the ESCAP region will need to have an assured and stable market in order to ensure that their efforts

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to utilize their natural resources are effectively rewarded by increases in their exports and foreign exchange earnings. The problems likely to arise in attempts to achieve these objectives require a multilateral approach for their solution in order to derive and share maximum benefits from the region's natural resources endowments and to take advantage of the proximity between countries having such natural resources and those with fertilizer deficits which cannot be met as efficiently by domestic production.

259. More reliable information than presently is available is required for the development of long-term trading arrangements based on comparative advantage. Beyond or in the absence of the subregional economic co-operation already suggested, there will be opportunities within the region to deal for mutual benefit with temporary surpluses and shortages which may arise unexpectedly in certain countries or subregions. Careful monitoring of these and als world developments is essential. Thus the improved supply of economic information on both regional and world developments, and reliable forecasts based upon it are urgently needed. It is recommended that in order to promote intraregional trade and subregional co-operation, international agencies and ESCAP member governments should cooperate to improve fertilizer economic information services which would give producing and consuming countries the results of continuous monitoring of national, regional and world trends and prospects in the demand, supply and prices of fertilizer raw materials, intermediates, products and transport services /Recommendation 47.

260. If co-operative production and trade arrangements along the lines suggested in the previous section occur among particular groups of countries within the ESCAP region, subregional information services would be an early component of the frameworks of such arrangements. However, there would still be a need for improved regional services to maintain a close watch of developments in the region as a whole and in other parts of the world. Improvements in economic information might also be a feature of the regional fertilizer development programme and subsequent centre proposed below (recommendation 11). But this approach could lead to delays which may deny improvements in information to governments and companies in time to help them avoid suboptimal investment decisions. It also risks submerging the crucial economic intelligence function beneath the weight of work on production technology which would be oriented towards national and technical interests rather than intercountry planning and trade developments. For these reasons the improvement of economic information should be accorded urgent and independent attention.

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261. The proposed improvements should be supported by existing regional institutions interested in economic information, investment, trade, and planning for regional co-operation in general and in fertilizer in particular. Intensive work could occur in the secretariats of either the United Nations regional commission (ESCAP) in Bangkok or the regional development bank (ADB) in Manila, and these agencies should join international institutions such as the World Bank Group, the UNDP, FAO, UNIDO and TVA's International Fertilizer Development Centre in bringing about the desired improvements, even if their main source were a new agency, constitutionally independent of existing organizations and located in a key fertilizer-producing or consuming country such as India or Indonesia. The support of both exporting and importing country governments could be expected for such services, since their output would reduce uncertainty and help avoid both unsaleable surpluses and dangerous shortages.

262. As well as performing general research and dissemination of information functions, such an agency might act as a catalyst and perhaps also a secretariat for intercountry arrangements to co-ordinate investment and plan trade along the lines suggested earlier. It could conduct or organize ad hoc studies on the feasibility of such arrangements at the request of individual countries or subgroups, and also assist studies on the feasibility of particular production complexes by maintaining both access to consulting services and staff expertise in the economics of the fertilizer industry, appropriate financing arrangements, raw materials and transport issues.

263. Pending the establishment of a new agency or arrangement among existing institutions to provide economic information, and perhaps as an introduction to help define its operational emphasis, several topics require urgent study in more depth than has been possible in the present UNIDO/ESCAP Priority Project. The objective of these economic studies would be to provide potential investors with the information necessary to plan trade-oriented production. It is therefore recommended that economic studies should be initiated immediately, by the ADB, ESCAP and international agencies working in concert, on fertilizer price trends, raw materials price trends, forward market conditions, the scope for trade arrangements and the availability and cost of ocean transport [Recommendation 5].

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264. These studies could be performed by various agencies, but close co-ordination should be maintained between them, and also with the related work of agencies such as the IBRD, UNCTAD, GATT and UNIDO. Their preparation should receive the substantive support of all countries of the region which may be importers or exporters of fertilizer raw materials and products during the 1980s. Among the topics which should receive early attention in this study programme are:

(i) world supply and price trends;
(ii) latest and likely intraregional and interregional market conditions;
(iii) identification of countries in which surpluses and deficits are likely to arise in the short- and medium-terms;
(iv) the scope for trade arrangements on a long and/or short-term basis involving fertilizer raw materials and the multiplicity of fertilizer products and services to avoid the danger of limiting the distribution of benefits;
(v) trends in the availability of shipping space and ocean freight rates; and
(vi) arrangements for exporting countries to participate in market development activities in the long-term importing countries.

Particular Industrial Development Projects

265. Technical and financial assistance for various projects to help the development of domestic fertilizer industries in particular developing ESCAP countries is considered in the follow chapter II. But several such projects are included here since they have strong implications for the trade and subregional economic co-operation recommended in general terms already. These refer to the development of: (i) potash in Thailand and perhaps Laos; (ii) rock phosphate deposits and phosphate industries in several ESCAP countries, inciuding sulphuric acid based on pyrites in the Philippines and India; and (iii) nitrogenous fertilizers production in Bangladesh and other possible surplus producers in ESCAP. In each of the cases substantial export is envisaged and in some of them assured regional or subregional markets would help justify the development of supply.

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(i) Development of Potash

266. Most potash requirements of the region so far have been met by imports, but the recent discovery of potash deposits in Laos and Northeast Thailand appears to offer an opportunity for the ESCAP region to become self-sufficient in supplies of potash salts for fertilizer production and direct application in agriculture. Tentative estimates indicate a minimum of at least 60 million tons of carnallite (90-95 per cent containing 17 per cent K_2O) in Thailand. The deposits lie on top of a vast evaporite residue of rock salt at depths varying between 100 and 150 metres in layers 30 to 50 metres thick, and are considered to be the most extensive yet found in the world. Sylvite (63 per cent K_2O) has also been traced in the same areas, mainly on the Laos side of the Mekong River where seams are 3 metres thick in association with the evaluation salt beds. Ten holes have been drilled in Northeast Thailand and one hole across the Mekong River in Laos near Vientiane. The Royal Thai Government's Department of Mineral Resources is continuing exploration for sylvite in the Korat Basin which lies to the south of the site of the carnallite deposits. The exact extent of the latter has to be determined by more drillings. Meanwhile the exploration in Laos has been temporarily suspended.

267. Several offers for exploitation have been submitted to the Government of Thailand but mining rights have not been granted yet. There is a vast area of ore which may be prospected in detail (56,000 km^2) before commercial exploitation is undertaken, and the constraints on progress are financial as well as organizational and legal. In addition, there are technical problems related to the admixture of potash with large quantities of rock salt including magnesium chloride. The existing infrastructure is not adequate to handle substantial quantities of salts, but the Thai Government has under consideration the promotion of soda ash and rock-salt export industries to deal with these salts in association with a potash industry. It is recommended that efforts should be increased to develop potash mining and production of marketable potash salts in Thailand and Laos for the benefit of the whole ESCAP region, and particularly to supply Thailand's ASEAN partners in exchange for other fertilizer nutrients [Recommendation 6(a)]. It is cautiously assumed however, that this mineral wealth will not start to play a role of any commercial significance until the mid-eighties.

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268. The Government of Thailand is continuing exploration for sylvite and requires technical assistance for further prospecting and evaluation. The Governments of both countries might approach the UN Natural Resources Division through UNDP Resident Representatives for assistance in equipment and experts to complete the geological surveys and expand drilling operations. The Mekong Coordinating Committee and UNIDO might co-operate in organizing studies to develop projects for the purification of magnesium chloride in the carnallite deposit, the disposal of waste, and the production of appropriate products for commercial use employing "appropriate" or "adopted" technology. ESCAP should co-operate in these activities, particularly by bringing the deposits and proposals for their development to the attention of the governments of developed countries, financial institutions and international agencies with a view to obtaining urgent assistance.

269. In addition to potash developments, there may be scope for subregional co-operation in the fertilizer industry as a whole for Mekong riparian countries, particularly those which are establishing other political and economic ties. The Democratic Republic of (North) Vietnam has phosphatic rock deposits, and has recently announced plans for nitrogenous fertilizer development with Japanese assistance. Natural gas has been discovered off the Republic of South Vietnam, and prior to the political changes which interrupted economic development programmes in 1975 this country also was exploring the possibility of establishing a nitrogenous fertilizer industry. With the recent sylvite discoveries in Laos as well, the subregion may have strong potential for integrated chemical fertilizer development including all basic nutrients. It is recommended that the development of the fertilizer industry and market in the Mekong riparian countries should be studied, the results of the study should be evaluation from the point of view of future regional co-operation, and appropriate subregional policies should be encouraged /Recommendation 6(b)/.

(ii) Development of Phosphate Raw Materials

270. The ESCAP region as a whole lacks sufficient quantities of rock phosphate to satisfy its long-term needs. Sri Lanka, Pakistan, and Afghanistan may have adequate supplies of rock phosphate to support their industries on a long-term basis, while Iran is investigating the feasibility of low-grade rock-phosphate mining, and, as mentioned above, North Viet-Nam is well advanced in the supply of phosphate rock from indigenous resources. On present indications,

/India

India will probably manage to meet little more than one-third of its requirements from its own resources, while the Republic of Korea, the Philippines, Indonesia and Bangladesh will remain dependent on foreign sources of rock supplies in the absence of sufficient deposits of commercial interest. The developing ESCAP countries' combined phosphate rock requirements by 1984/85 will exceed local supplies by more than 5 million tons, although an important source of supplies will be the new Queensland deposits in Australia. To alleviate the very tight supply situation and high prices of rock in the world market, it is necessary that more concerted efforts be taken in finding new deposits and in improving beneficiation techniques for upgrading existing rock of lower grade.

271. The discovery of on-shore deposits of phosphate rock in Australia, India, Iran, Pakistan, Afghanistan and Sri Lanka, is of considerable economic interest to the ESCAP region as a whole as well as to the countries concerned. Experience gained already in the exploitation of deposits, particularly in India and Pakistan, should be combined to assist the development of the industry in the region. Apart from Australia, India may have the biggest potential for the development of rock-phosphate deposits, especially in Rajasthan (Dhamara-kotra). It is recommended that a Regional Phosphate Development Programme should be commenced urgently to ensure concerted co-operative action in the ESCAP region as a whole, in addition to steps taken by individual countries, to mine and use phosphatic rock for fertilizer production /Recommendation 7(a)/. In addition, it is recommended that long-term agreements should be reached to secure supplies of low-cost phosphate rock from countries within the ESCAP region (such as Australia) or from ECWA countries /Recommendation 7(b)/.

272. The programme should be designed immediately by UNIDO and ESCAP and financed by the UNDP on a five-year basis. Its components should include:

(i) a high-level committee of experts from the countries concerned to assist in co-ordinating the speedy development of prospecting, mining, beneficiation and use in facilities production of phosphate rock;

(ii) geological co-ordination to avoid duplication of efforts and to promote a study on common characteristics of the rock of India, Iran, Pakistan and Sri Lanka;

(iii) technical assistance for visits by appropriate authorities from the countries concerned to other countries like Brazil and the USSR to study their development of similar ores as also to such countries as the United States, Morocco, Australia, Jordan, Syria, Togo, Senegal and Algeria; which are now engaged in such activities;

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(iv) a study on reactivity, and either beneficiation studies or pilot plant work to develop appropriate technology in using the indigenous rock for fertilizer production;

(v) exercises to work out changes in design to equipment in existing plants utilizing indigenous rocks so that they can use higher percentages of indigenous rock and to establish design criteria for future projects to use 100 per cent indigenous rock;

(vi) dissemination of information on cost and price trends and on world development of phosphate ores and phosphatic fertilizers;

(vii) appropriate technical meetings and studies on the subject; and

(viii) the use of experts as required to advise on the development of phosphate rock in the countries of the region.

273. Since there is a general deficiency of sulfur in the region, pyrites need to be taken into consideration for the production of by-product sulphuric acid required for the manufacture of phosphatic fertilizers. Sulfuric acid produced in plants constructed in connexion with pyrites-roasting facilities in metallurgical industries is quite suitable for the processing of phosphate rock. In the Philippines and India, where pyrites-roasting is already applied for processing of copper ores, the development of sulphuric acid production should be further promoted. Although no direct relationship exists between the need for development of the copper industry and the demand for increased fertilizer production, the economics of both branches of industry are interdependent to some extent. Development of pyrite processing should be therefore given priority, wherever feasible, taking into account the possibility to produce cheap sulphuric acid as by-product. It is recommended that India and the Philippines should co-operate in the development of pyrites-processing and by-product sulphuric acid technology, and accord priority to the development of their phosphate industries /Recommendation 8(a)/. India and the Philippines could combine their efforts by exchanging experience and technical know-how on a bilateral basis for the mutual benefit of both countries. In each case careful consideration should be given to whether the sulphuric acid produced should be available for export to the region as well as being consumed by domestic fertilizer industries.

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274. The Philippines particularly should be encouraged to play an increasing role in phosphate fertilizer production to meet the needs of ASEAN and perhaps the ESCAP region as a whole. Therefore it is recommended that the Philippines should develop an export-potential in P_2O_5 based on sulphuric acid from copper-smelting, ensuring markets through bilateral trade agreements to meet the needs of Indonesia and other countries in the ESCAP region, particularly ASEAN-members /Recommendation 8(b)/. After the conclusion of arrangements for the construction of new copper ore processing complexes in the Philippines, a feasibility study on the development of the phosphate fertilizer industry should be conducted, with the objective of evaluating the quantity of sulphuric acid which will be available. It should also take into account possible regional supplies of phosphoric acid or phosphate fertilizers. UNIDO and ESCAP could assist in making this feasibility study pending the establishment of an ad hoc fertilizer institution or a comprehensive phosphates development programme in the region or ASEAN subregion.

275. Bilateral trade is already under discussion between the Philippines and Indonesia, consisting of the exchange of liquid ammonia from Indonesia for fertilizer produced in the Philippines. It would be desirable for a great deal of Indonesia's future demand for phosphatic fertilizers to be covered by supplies from the Philippines on a long-term basis in exchange for nitrogenous fertilizer raw materials, intermediates or products. In the event of an abundance of sulphuric acid occurring in the Philippines, similar bilateral agreements should be made with other countries in the region which have fertilizer or other commodities to export in exchange for phosphate fertilizers. No immediate action is required as such arrangements await future development of the industry. However, organizations financing projects in the metallurgical industry might seek assistance now in order to determine the possible demand for acid resulting from the establishment of large export-oriented diammonium phosphate or complex NPK fertilizer plants in the Philippines. Although the latter's plans are not yet firmly fixed it is clear that a large phosphate fertilizer industry based on by-product sulphuric acid and imported rock-phosphate may be feasible under prevailing economic conditions.

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(iii) Export of Nitrogenous Fertilizer

276. Although several ESCAP countries have discovered natural gas, the feedstock situation will remain an important constraint on the future development of the nitrogenous fertilizer industry in the region as a whole. Even countries such as India and Thailand, which have oil and gas reserves, are expected to find that insufficient quantities or competitive alternative uses for them make the satisfaction of demand for nitrogenous fertilizers by imports from other countries within the region more economic that reliance on domestic production for self-sufficiency. Among the countries which do have sufficient feedstocks to support an export industry, some may tend to conserve indigenous resources for prolonged exploitation in order to cover future domestic demand. However Bangladesh, and perhaps also Brunei and Burma as well as Iran and Indonesia, appear to be in a feedstock position which allows for the planning of export for the period from 1983 onwards when a regional imbalance in the supply/demand situation is expected to expand rapidly.

277. Of these gas-rich countries, Bangladesh may be the most important potential supplier of nitrogenous fertilizers for its deficit South Asian neighbours. Meanwhile the prospect of an intervening short-period of regional surplus is hampering progress, and it is therefore recommended that assistance should be given to assessing the economic feasibility of the development of the gas-based nitrogenous fertilizer industry in Bangladesh. Some effort may be necessary to ensure the feasibility of future rapid development in the industry, since a urea complex of optimal size, operated efficiently, would increase supplies to the regional market in large measure as soon as it was brought on stream.

278. In order for the country to become and remain a regional supply centre in the future, it will be necessary to begin trade co-operation in advance. The increase of urea production in Bangladesh planned for 1978 offers an immediate opportunity to start co-operating with future potential deficit countries before their deficits occur as an economic problem. It is therefore recommended that trade agreements should be concluded to enhance this industrial means of exploiting the indigenous resources, while other means should be sought in case of a temporary fertilizer surplus /Recommendation 9(b)/. Even though present plans may not make Bangladesh attain self-sufficiency itself by 1978, the early establishment of trading partnerships is desirable when ready markets exist. A thorough study on this issue might indicate the feasibility of installing additional facilities earlier than would be justified by the local supply and demand situation alone.

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279. The willingness of Bangladesh to expand its fertilizer production as soon as possible is not in doubt. Nevertheless, there is a need for assured export markets. Detailed studies to assess these and the promotion of bilateral long-term export agreements might be assisted by ESCAP, particularly in the light of the possibility of a surplus supply-demand balance in India for the 1978-82 period. Early action to help Bangladesh avoid dislocations in the smooth development of its industry should be taken immediately by representatives of those Asian countries interested in assured future supplies of nitrogenous fertilizers. Such action could include planned trade agreements with Bangladesh and/or direct investment in its fertilizer industry to facilitate assured exports, or perhaps investment in other industries which would permit the economic and urgent exploitation of its gas resources.

280. Since the future raw material situation for production of nitrogenous fertilizers in the ESCAP region does not appear to be satisfactorily clear yet, countries will want all production possibilities in the region to be studied in detail before subregional, regional or inter-regional arrangements are concluded. Three possible sources of nitrogen which have not been considered seriously in the present study are Brunei, Burma and Singapore. In spite of its lack of natural gas, Singapore may be interested in establishment of an ammonia/urea complex based on naphtha or fuel oil available locally from its petroleum refining activities. If proximity outweighed the normal cost disadvantage of these feedstocks, this could be an additional source of nitrogen for the region. However, it can be presumed that planning will not proceed without the expectation of an assured market.

281. As for Brunei and Burma, natural gas is already available. In the former, almost all of the gas exploited so far is exported in the form of LNG to Japan. However, a ammonia/urea complex based on gas from a recent further finding is to be seriously considered. This would be able to supply nitrogen at competitive prices to the region in the eighties, provided market conditions permit. The lack of a market in the short-term might prove a problem to Burma also, and consideration of the production and export prospects of the new gas-based plant now under consideration there should be of interest to deficit countries and other export-countries as well as to Burma itself.

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282. In order to ensure that the region's nitrogenous fertilizer needs are fully and efficiently served, and that production potential is exploited on a viable basis, it is recommended that feasibility studies dealing particularly with the export market should be undertaken for Singapore, Brunei and Burma as soon as the results of more general studies on the world and regional market situation in nitrogenous fertilizers become available /Recommendation 10/. UNIDO may be the appropriate executing agency for country projects to meet possible requests from these governments, with assistance from ESCAP on trade aspects of the problem. Alternatively the studies could be conducted by the prospective financing institution for each new plant, assisted by the prior evaluation of the regional and world market situation recommended above.

/Chapter II:

Chapter 11. [illegible] productivity

Regional Fertilizer [illegible] Centre

283. This chapter includes [illegible] recommendations for technical and financial assistance for projects which should improve the productivity and assist the development of the chemical fertilizer industries in developing ESCAP countries. Most contain an element of co-operation among countries of the region, although considerable initiative and support is expected to be supplied by international agencies. Regional co-operation in this context is largely a technique for the receipt and exchange of advice and experience, in contrast to the projects recommended in the previous chapter which are mainly oriented towards the industry's development on a regional or subregional, rather than national basis, and in which inter-country economic co-operation is more important than external assistance. The most general of the recommended projects outlined here is the establishment of a comprehensive Regional Fertilizer Development Programme and, subsequently, a Centre, whose primary but not exclusive task would be to assist ESCAP developing countries plan, install and operate high-productivity fertilizer facilities.

284. There is now no regional or central institution in the ESCAP region to collect and analyse data on new technologies and products, to supply or arrange expert assistance to production facilities in developing ESCAP countries, or to monitor developments referred to in the section on information services in the previous chapter. The region is well advanced in fertilizer production, compared with other developing regions of the world; moreover some countries are endowed with abundant gas and oil resources for nitrogen production on a large scale and recently phosphate and potash deposits have been discovered. However, the planning for new plants to satisfy the needs of the region and to achieve regional co-operation is hampered by a lack of institutionalized information and planning. Efforts are dispersed and targets conflict. To prevent this, plans for the development of the fertilizer industry and the present activities

of ESCAP member governments need to be co-ordinated, and a wide range of technical co-operative links in order to obtain lower costs and more rapid implementation of projects.

285. An institution is necessary to ensure continuous intergovernmental contact, ad hoc arrangements, preparation for sub-regional economic co-operation, as well as to provide technical advice and assistance to particular projects. There is a strong trend to establish industrial development centres to meet similar needs in other developing regions of the world. For example, the UNIDO has agreed in principle to finance a Fertilizer Development Centre for Arab States in co-operation with IDCAS, and TVEC is assisting in setting up this centre. In line with this trend, it is recommended that, in order to promote and co-ordinate the future development of the fertilizer industry in ESCAP countries on a regional and sub-regional basis, and to provide technical assistance and information required for national decision-making, a regional fertilizer development programme should be established in the ESCAP region. /Recommendation 117. This programme could commence with UNDP/UNIDO/ESCAP assistance pursuant to preliminary efforts by UNIDO to promote it in Indonesia. The basis could be similar to that of the unit established for the Arab States but adapted to the needs of the ESCAP countries. UNDP assistance would be complemented by host-country and member-country inputs of staff, equipment and finance in the first five years, after which the programme could become a self-supporting Regional Fertilizer Development Centre.

286. Its objectives should be to stimulate and support the expansion of the fertilizer industry and to organize all forms of regional co-operation related to fertilizer production and trade, through such activities as:

(i) Assistance for regional planning, promotion and co-ordination;

(ii) Advice to member countries on infrastructure, marketing and distribution, transport, location of plants and inv investment;

(iii) Arrangement of training facilities for operation, maintenance, marketing and managerial personnel;

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(iv) Adaptation of imported technology to suit conditions in the countries concerned; application of research findings in fertilizer technologies to improve processes and utilization of equipment; advise on appropriate technology;

(v) Assistance in drawing up standard contracts;

(vi) Standardization of plants and equipment based on feedstocks available in the region; standardization and quality control of products;

(vii) Information and documentation services;

(viii) Development and assistance in engineering and design capacities in member countries and the need arises; assessment of equipment supplies; and evaluation of proposals to set up fertilizer plants; and

(ix) Co-ordination and centralization of fertilizer economic information services through the collection of information on existing production capacity, planned capacity and supply-demand projections, and by acting as a clearing house for world-wide information on price trends;

Projects on Technology and Management

287. Once established, the Regional Fertilizer Development Programme might incorporate many activities aimed at raising plant productivity and otherwise assisting development of the industry in developing ESCAP countries. In the meantime, several projects should be proceeded with on an urgent basis to combine external assistance with regional co-operation in achieving particular improvements in existing and new installations. These recommended here are:

(i) A regional catalyst development programme or centre;

(ii) Model maintenance courses;

(iii) Manpower training programmes and centres;

(iv) Purchasing and contracting arrangements;

(v) Teams for assistance in start-up operations;

(vi) A study and symposium on mixing plants; and

(vii) A workshop and study on management structures.

These seven projects are discussed in this section.

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(i) Regional Catalyst Development Centre

284. Countries of the ECAFE region are expanding their fertilizer production and capital goods facilities at a rapid rate, notably with respect to ammonia, sulphuric acid and nitric acid, while further petrochemical developments are also taking place in related fields. One of the key technological factors involved in such developments is the use of catalysts, and certain countries of the region have built up expertise in their production, standardization and quality control, and use. On an international level, UNIDO has conducted expert group meetings on the subject and has compiled a Directory of Catalysts and Catalyst Producers. Training in catalyst technology is also provided in countries like the USSR and Romania. It is essential that the region should both improve and make use of its know-how in the production and use of the catalysts used in such processes as sulphur removal, steam reforming, carbon monoxide conversion, methanol synthesis, methanation, vanadium pentoxide, and sulphuric acid, etc.

289. To assist this, it is recommended that existing facilities in the ECAFE region should be expanded to form a Regional Catalyst Development Centre in order to assist member countries in research, production, standardization, quality control and training aspects of the use of catalysts. /Recommendation 19/. It is proposed to attach this centre to existing facilities in India. Technical expertise, pilot plant demonstration and testing equipment, instrumentation and laboratory equipment for initial operations would have to be procured with financial and technical assistance from UN agencies, particularly the UNDP and UNIDO, from the host-government and from developed countries, among which the project could be promoted by ESCAFE. However, a task force should be recruited within the region to supervise the establishment of the centre, while longer-term financial needs might be met by annual contributions by ESCAFE member governments and companies of the chemical industries interested in being serviced by the centre.

/(ii)

(ii) Model Maintenance Programmes

290. Adequate and timely maintenance of fertilizer plants is one of the most important factors ensuring their effective operation. The organization of maintenance is a specific managerial issue which needs consideration during the design, procurement of equipment and spare parts, start-up and continuous operation stages of new and existing plants. Preventive maintenance should be assured on all plants and relevant schemes should be worked out well before normal operation is commenced. The improvement of on-stream factors of existing plants, as well as the preparation of successful start-up for new plants, requires support from precise maintenance programmes.

291. Many plants in developing ESCAP countries appear to have sustained procedural difficulties in obtaining spare parts to replace damaged equipment, resulting in long delays in resuming operation or in bringing plants up to full capacity utilization. It is essential that plants have a sufficient inventory of spare parts from commencement of operations. In view of long delivery times for certain items, initial spare parts inventories must be substantial and, in some of the best operating plants in the region are as such as 8 per cent of the C + F value of equipment. It is equally important for governments to streamline procedures in order to provide adequate facilities for the import of spares, and for establishing a mechanism for rapid execution of financing and import procedures in the event of a major breakdown, such as occurred recently in one country of the region. Even a short stoppage of production in a large modern plant can result in a cost for fertilizer imports to replace lost production greatly in access of the spare parts cost.

292. To avoid and deal with these problems, it is recommended that <u>model maintenance programmes should be implemented for the improvement of maintenance planning and organization in existing and new plants in the ESCAP region and that these programmes should be taken into consideration during negotiation on contracts for new plants</u>. /Recommendation 13/. The programmes should facilitate the transfer of well-established procedures from efficient existing fertilizer plants, and preventive

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maintenance manuals need to be developed, strictly observed, and given proper priority by the management as part of plant training courses. The programmes for new plants should be involved at both pre-investment and start-up stages, and in the former case should help ensure the ample supply of spare parts and the procurement of high-quality equipment with guaranteed continuous on-stream time above 8,000 hours/year. Adequate staffing and adequate supplies for maintenance workshops (machinery and tools) should be secured by help of these programmes prior to start-up.

293. The models should be based on practices employed in the fertilizer and petrochemical industry in developed countries, although provision should be made also for consideration of different working conditions in ESCAP countries as well as for a lower level of know-how in the field of mechanical workshop operations. Substantive terms of references of the project should cover mainly issues related to:

(i) planning of maintenance and repair,
(ii) procurement and storage of spare parts,
(iii) monitoring of maintenance operations (machine charts, reports and accounts),
(iv) organization of workshops including staffing,
(v) requirements on engineering and design services,
(vi) subcontracting of specialized operations,
(vii) planning and execution of annual and general overhauls of machines including biannual plant shut-downs, and
(viii) technical managerial, organizational and economical aspects on preventive maintenance.

294. Since the model maintenance programmes are assumed to become a basic tool for the improvement of plant operations in the fertilizer industry in developing countries, they should be initiated by a study carried out either by experts of one of the developing countries within the region or with help of experts of developed countries sent to one

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of the developing countries concerned. With UNIDO as executing agency, the UNDP should be approached to provide finance for the employment of two experts familiar with conditions in the heavy chemical industry in newly-developed and developing countries: one a specialist in the organization of maintenance of mechanical equipment, the other a specialist in instrumentation. Countries to be visited by the experts in order to adapt procedures to conditions prevailing in the region might be Korea, Indonesia and Pakistan.

(iii) Manpower Training Programmes and Centres

295. Training programmes in many existing NCNP fertilizer plants are inadequate, and exist only at the senior engineering level. With substantial capacity available, it should be possible to provide training facilities for both engineers and technicians within the region. Moreover, the rapid current and future development of the fertilizer industry entails an increased demand for skilled manpower to the extent not before encountered in any of the countries concerned. Large production units will be set up within the next few years, some of them in countries with no or little industrial background, and staff training requires careful consideration as one of the most essential prerequisites for effective plant operation. In particular, the training of operators, supervisors and technicians, as well as that of engineers, needs to be commenced well in advance of start-up schedules. In order to provide adequate training facilities for the wide variety of specialities required, mutual efforts need to be concentrated in those countries where training courses for higher and medium level staff can easily be organized as extension of existing specialized training centres.

296. Several countries in the region have existing large production units which are well-managed and operated effectively and some of these are already being outfitted with plant operation simulators or other auxiliary training equipment, while elsewhere parts of existing production units are being made available to training purposes. Thus in-plant training may be feasible for large groups of operators over an extended period to ensure proper adoption of knowledge by them and unskilled workers or semi-skilled craftsmen who are transferred to new fertilizer plants from

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other industries. It is proposed that two training programmes should be launched as extensions of existing training facilities to serve the fertilizer industry of the ESCAP region. /Recommendation 14/. The regional training programmes should be initiated with two centres, perhaps located in Pakistan and the Republic of Korea, and should comprise:

(i) training courses for improvement of plant management and supervision of operators;
(ii) in-plant training of plant operators and supervisors;
(iii) in-plant training of maintenance organizations; and
(iv) in-plant and workshop training of mechanical and instrument draftsmen.

297. The scope of arrangements envisaged implies the extension of present housing and classroom facilities for theoretical training as well as the provision for additional space at factory sites to accommodate larger groups of trainees. Co-ordination of training programmes and schedules among ESCAP countries should be taken over by the centres in collaboration with the proposed regional fertilizer development programme. The initial phase of establishing and developing the programmes will need external financial support and it is proposed that UNDP be approached for this purpose. UNIDO should accord priority to the provision of initial expertise on a regional basis. Voluntary contributions by the governments of both host countries and/or the allocation of additional assets by companies which at present are the nominal owners of the existing training facilities should be invited as well. In the longer term the financial basis should be agreed upon bilaterally between each of training centres and the various governments or companies interested in using them.

(iv) Purchasing and Contracting Arrangements

298. The contracting of fertilizer plants, production lines and single items of equipment has created problems in developing countries where technical and commercial staff is not always aware of all details which need to be taken into consideration prior to signing the contract. There are well-known cases of shortcomings in the quality of materials and equipment leading to low performance of new plants. In some cases the formulation of guarantees and test-run procedures were inaccurate,

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preventing later claims for the replacement of faulty items or improvement of plant operations from being effected within the contractors liability. In placing contracts for plants to be established in developing countries, it is essential to draw up comprehensive and detailed contractual obligations and specifications. Contracts need to contain provisions for absolute guarantees for demonstrating capacity and product quality, without limitations on the contractors' liability. Guarantees should be demonstrated in test-runs over relatively long periods not merely the 72-hours as is common in developed countries.

299. A standard contract for the purchase of plants in developing countries would be of substantial assistance to these countries, as well as setting a pattern for future contractual negotiations. Therefore it is recommended that in order to facilitate the successful installation of new fertilizer facilities in the ESCAP region, (a) a continuous dialogue should be commenced among representatives of countries having experience in contracting fertilizer plants, production units and principle items of equipment; and (b) general guidelines should be prepared on contract formulation, pertinent international practices, sellers' and buyers' liabilities, etc. /Recommendation 15/. The project should provide for experience related to contracting of fertilizer plants and equipment to be collected, pooled and made available to investors for preparation of subsequent contracts. Technical and economic issues should be reviewed and shortcomings in contract formulation should be revealed. Experience on selection of reliable equipment suppliers, identification of proper construction materials for critical equipment and definition of guarantees, test procedures, etc., are to be exchanged among ESCAP countries.

300. UNIDO should implement the project in co-operation with national organizations assigned by the governments concerned, but finance should be arranged jointly by the UNDP and the Government of the first host country, which might be Pakistan, to support the acquisition of both external and regional expertise, travel and subsistence allowances for ESCAP member countries' participants, expert fees for the preparation of the general guidelines, and contingencies related to the organization of the meeting. Subsequent host countries and time-schedules would be agreed upon by the first meeting, and further activities could be organized by the proposed regional fertilizer development centre, with meetings on this particular topic convened annually in different countries of the region.

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(v) Teams for Assistance in Start-up Operations

301. Forty plants will be put on stream during the next six years in ESCAP member countries. As many of these are technically very similar, it would be unfortunate if experience could not be shared in order to avoid mal-operation during start-up, faulty instructions, lack of practical knowledge of how to avoid emergency situations while new plants are set into operation, and other roots which have been responsible for prolonged gestation periods and high commissioning costs in the past. Adequate practical know-how base for successful start-up and effective plant operations is available in the region, and the existing and steadily increasing experience of start-up operations should be used for bringing future ESCAP plants on-stream. It is recommended that the exchange of regional teams for assistance in start-up operations should be organized to exchange experience on start-up operations and to facilitate technical assistance during the period of initial production in order to prevent the mal-functioning of new plants in the ESCAP region. /Recommendation 15/. These working groups should be qualified in effective start-up procedures and should be exchanged among countries on a bilateral contractual basis whenever requested. Existing national organizations which have comprehensive know-how and capability to organize regional start-up teams should be encouraged to take the leading role in the region and to set up the first teams.

302. Assistance should be extended not only to plants based on "battery limits design", but also to plants where management contracts for start-up, commissioning and initial production are part of a general contract on a turn-key basis. Since management contracts may not cover all issues which need attention, especially specific organizational measures related to employment and continuation of in-plant training of local staff, regional assistance should be invited and executed alongside external services in management and plant supervision. A regional project executed by UNIDO would help to organize the first regional team, and facilitate the participation of certain experts qualified in management services for start-up and commissioning as well as for organizational services and mechanical and instrumentation maintenance. However the first phase of the project would concentrate on start-up assistance and

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might be subcontracted to a well-established consultancy or management-service company working in this field in a developed country. Joint-financing could be provided by the UNDP and the governments of the countries where the terms will be fixed.

(vi) Improvement of Mixing Plants' Operations

303. Fertilizer-mixing plants operated in ECAFE countries embrace a wide range of processes and specialized equipment. Many different mixed and compound-formulated fertilizers are produced in these plants, in several of which serious technical problems have arisen. While some of the problems are due to supply of raw material of inadequate quality, most seem to have their origin in plant design deficiencies or lack of operating experience. Reconstruction of some of the facilities may be necessary in order to improve plant output and product quality, while in some cases the overhaul of facilities for handling raw materials and products within the plant sites is required. It is recommended that a study should be conducted and a symposium convened in the ECAFE countries to exchange experiences related to the production of blended and compound fertilizers, with a view to the improvement of mixing-plant operations in the region. /Recommendation 177.

304. Participants from all ECAFE countries where mixing-plants are operated, and representatives of selected engineering companies within the region should be invited to the symposium, the main working team for which should consist of technical plant managers and maintenance engineers. An expert from a developed country should assist the meeting by preparing a short survey of the actual status and development of the fertilizer-mixing and compounding technology. The symposium, lasting one week, might be hosted by Thailand, Sri Lanka, or the Philippines, while engineering company representatives might be invited from the Republic of Korea, India and Pakistan. FAO should be the appropriate executing agency for the project, with finance assured jointly by the UNDP and the host government. Follow-up action to continue the exchange of experience among mixing plant operators could be organized separately,

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based on the findings and recommendations of symposium participants. In addition, at the request of governments, specific feasibility studies on corrective engineering might be subcontracted and covered by additional financial arrangements. Engineering services should be provided from countries of the region where adequate know-how is available and possibilities of supplementary equipment manufacturing exist.

(vii) Workshop and study of management structures

305. The management structures within plants in the region need further strengthening. Since inadequate management, both general and technical, may be considered responsible for low efficiency of some of the existing plants, an in-depth study of management structures needs to be undertaken. In some developing countries plants are operated at or above rated capacities, while similar plants elsewhere cannot reach their design targets. Higher unit costs of production in underutilized plants than those achieved in highly efficient plants in the region justify the investigation of organizational as well as technical reasons for low productivity. In order to ensure that all factors contributing to low capacity-utilization are analysed, it is recommended that a regional workshop should be convened to exchange experiences of management structures in existing UNDP fertilizer plants, assisted by comparative study on management of highly efficient and under-utilized plants, and including the elaboration of improved management structures for large and small fertilizer plants. /Recommendation 137/.

306. The comparative study should be carried out by experts and managers after having visited selected plants which can offer good opportunities for investigation of reasons affecting or positively influencing productivity. The various elements of the project could be financed by the UNDP and executed by UNIDO, with assistance in preparing its terms of reference being rendered by UNIDO and/or ILO. Countries which might usefully be visited are the Republic of Korea, Indonesia, Bangladesh, India and Pakistan. The first-mentioned might be an appropriate host for the workshop and might provide part of the financial support for the study team. It is envisaged that the proposed Regional Fertilizer Development Centre, once established, would include within its functions the regional exchange of experience among plant managers.

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Chapter 12. Other Technical and Financial Assistance

307. The preceding two chapters have identified several areas where technical and/or financial assistance might promote economic co-operation among developing ESCAP countries and help raise the productivity of their chemical fertilizer production facilities. By way of summary, it may be noted that those aspects of the industry, treated so far, which have specific scope for external assistance and other activity on the part of developed countries, international agencies or multinational corporations, as well as participation by developing ESCAP countries, include:

- schemes for industrial or market integration including foreign private or public investment or aid;
- improvement of economic intelligence, including information and analysis;
- potash development in Thailand and Laos;
- subregional economic co-operation among Mekong riparian countries;
- regional phosphatic rock and fertilizer development and procurement;
- co-operation in sulphuric acid production in India and the Philippines;
- nitrogen export feasibility studies and trade arrangements for Bangladesh;
- export market studies for such countries as Singapore, Brunei and Burma;
- a regional fertilizer development programme and centre;
- a catalyst development centre;
- model maintenance programmes;
- manpower training programmes and centres;
- co-operation in purchasing and contracting arrangements;
- teams for assistance in start-up operations;
- co-operation in mixing plant operations; and
- co-operation to improve management structures.

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In addition to these, there are several areas where co-operation among countries on an economic basis is less important or where issues other than productivity are involved. This chapter covers such aspects, especially:

- the domestic marketing and distribution of fertilizer, and the use of slow-release nitrogen;
- various country projects, including studies on possible developments for Thailand and Afghanistan, and in addition to those mentioned above for Singapore, Brunei, Burma, Bangladesh, India, and the Philippines, and the Mekong riparian countries; and
- the financing of new facilities.

Marketing and Distribution

308. The anticipated trends in fertilizer consumption growth fall short of the amounts required to meet food grains self-sufficiency targets in most of the countries of the region. Effective marketing is necessary to ensure the estimated consumption levels in the 11 countries studied, totalling about 11 million tons N and 4 million tons P_2O_5 by 1985, since any slowing-down of the consumption growth rate not only would seriously constrain the development and raise the operating costs of the fertilizer industry but also would have serious repercussions for the food self-sufficiency efforts of the region. The indications in chapter 7 that anticipated growth rates of demand are likely to bring about a surplus of nitrogenous fertilizer by 1980 but a deficit again in 1985 suggest that high priority should be placed on expanding consumption to ensure that more of the growth occurs within the next four fertilizer years up to 1979/80. Effective demand for phosphates also needs to be expanded rapidly to attain a more balanced application of nutrients in Asian farms.

309. It is therefore essential to further develop and where necessary reform the existing promotional, marketing and distributional infrastructure in each country to convert potential fertilizer use into effective demand. Such infrastructure needs to be developed in order to service national policy objectives well ahead of the time that the fertilizer from the new indigenous plants becomes available. It will also have to take into account prevalent practices, available facilities and agricultural extension services. Since fertilizer demand is a derived demand from agricultural development, the fertilizer promotion efforts

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must also be closely linked with the agricultural development plan of each country. Moreover, the cost/benefit ratio — i.e. the difference between the cost of a given amount of fertilizer and the value of the agricultural produce derived from the farmer's use of it — must be minimized in order to increase fertilizer consumption to desired levels.

310. To assist these developments by furthering work already commenced by the FAO and the ESCAP Task Force on Fertilizer and Agricultural Chemicals, with the assistance of the Netherlands Government, it is recommended that general comparative studies should be expanded and a regional symposium convened on fertilizer marketing and distribution infrastructure and problems in ESCAP countries. [Recommendation 19(a)] The study and symposium should cover the following aspects of the problem:

(i) the role of institutional agencies: between fertilizer manufacturer/importer and consumer - the farmer; for supplying other agricultural inputs and marketing of farm produce; for participation in rural credit-disbursement and realization mechanisms; and for storage and for putting the fertilizer within easy access to the farmer;

(ii) the role of private trade in: the provision of wholesale fertilizer trade facilities; retail selling points near the farms; participation in government rural credit disbursement schemes; the marketing of farm produce; and promotional efforts;

(iii) co-ordination between agricultural extension organizations down to the village level and the national fertilizer distribution system;

(iv) market expansion, particularly among small farmers;

(v) evaluation of existing facilities for the extension of laboratory findings on seeds, fertilizer application and soil chemistry, as well as the correlation of the findings of soil analyses with recommended optimum fertilizer dosages and the mechanism for conveying the recommendation to the farmer;

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(vi) effects of cropping patterns, sizes of land holdings and agricultural promotional work; and

(vii) cost/benefit ratios and support prices for farm produce.

311. Distribution costs, one aspect of them particularly the cost of packaging and transport from the factory, form a substantial element in the total costs of fertilizer delivered to the farm gate. These, therefore, need to be closely monitored and systems evolved to minimize expenditure on these accounts. In order to achieve cost savings on packaging, storage and transportation of large quantities of fertilizers, the use of low-cost packaging materials and the expansion of bulk transport require to be investigated and implemented as soon as practical. Currently most fertilizer used in the ESCAP region is packed in expensive polythene-lined jute bags or woven polypropylene bags. Bulk transportation is applied only to an insignificant degree. Since climatic conditions and consumer requirements are not very dissimilar amongst the countries of the region, there may be considerable scope for joint efforts to discover improvements in these fields. It is recommended that a special study should be conducted on improved fertilizer bagging and bulk transport techniques in the ESCAP region [Recommendation 1)(b)].

312. This special study on improvements of fertilizer bagging and bulk transport should be designed to yield suggestions for improving the share of bulk transportation in the entire fertilizer distribution system. It should therefore consider the packaging, storage and transportation facilities available for bulk and semi-bulk movement of fertilizer, in order to make positive suggestions on what facilities may need to be improved or provided to accelerate the establishment of bulk or semi-bulk movement of fertilizers. Moreover, the study should seek to identify practicable techniques to ensure both material and cost savings, and to provide information and advice to countries where circumstances allow for the application of improved methods. It should cover:

(i) bagging and transportation techniques so far employed in the region and review of materials and equipment applied in developed countries;

(ii) usage of bulk and container transportation techniques suitable for the prevalent handling practices/devices in rural areas and climatic conditions in the region;

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(iii) measures to be undertaken and incentives required for promotion of optimal product handling methods.

313. Through efforts to deal with these and other problems of distribution, urgent attention should be accorded to the acceleration of consumption because of the inherent time lag in the adoption of ideas by the farmer after he has accepted them - at best he can apply them only in the following crop season. In each country, therefore, steps should be commenced immediately to identify the magnitude and status of the constraints on consumption, and to evolve effective solutions for problems associated with transportation, handling, storage, the distribution network down to farm-level, the role of existing institutional agencies and their future development, promotional work related to disbursement, fertilizer and food pricing and subsidy measures, as well as the provision of rural credit and complementary inputs and the effective marketing of farm produce.

314. Strong, sustained and concerted efforts along each of these lines is necessary for effective fertilizer market expansion to occur within an integrated approach to agricultural development. To deal with the pricing and VCR factors among these aspects, it is recommended that comparative economic studies should be expanded on ESCAP member Governments' fertilizer pricing policies and the optimization of subsidies and import taxes on fertilizers and fertilizer raw materials, in order to establish recommended value-to-cost ratios to help governments develop consistent and flexible relationships between fertilizer and crop prices. [Recommendation 19(c)]. Other approaches might be adopted for the various institutional and ancilliary entrepreneurial aspects. Although these efforts are basically necessary at country-level, some ESCAP countries have been more successful than others in dealing with different aspects of the problem of getting the fertilizer on to the farm. Thus there is considerable scope for the mutual exchange of experiences and as inter-country comparison of techniques available for adoption in dealing with similar agricultural products, climatic conditions, transport systems or subsidy problems.

315. The expansion of the general comparative studies should include work by a team of experts assisted by country counterparts experienced in fertilizer marketing and distribution. The expert team would consist of a marketing and distribution expert, an expert experienced in agricultural co-operative systems and an agronomist with experience of promotional work. It could be especially

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beneficial to evaluate existing systems in such countries as Bangladesh, India, Indonesia, Republic of Korea, Pakistan, the Philippines and Thailand. The same countries should be included in the special study on bagging and bulk transport, which would be conducted by two experts, an economist familiar with the region and an expert in the topic. Parts of the general study are already in hand through co-operation between the ESCAP secretariat and the FAO Regional Office, but more detailed country-level investigations are necessary. UNDP and UNIDO support should be sought to assist with these, with the bagging and bulk transport and price and VAT studies, and with ESCAP's organization of the proposed regional symposium on fertilizer marketing.

316. An aspect of marketing, distribution and use which is significant for product technology in the industry is promotion of the use of slow-release nitrogenous fertilizers in order to conserve nitrogen. Products like sulphur-coated urea, IBDU and urea formaldehyde may have considerable potential value to the ESCAP region. Work with these products has indicated promising results from different parts of the world. Further work is warranted, however, since there are inconsistencies in the evaluation of the results and contradictory opinions still prevail. In India trials have indicated that this type of fertilizer will have not only an agronomical advantage over straight urea, but also commercial possibilities because of large acreage under submerged paddy, where a special type of fertilizer should be applied.

317. It is recommended that research on the use of slow-release nitrogenous fertilizer should be intensified within the ESCAP region, with promising materials being tested and demonstrated at a regional meeting. [Recommendation 20] The research should help determine the scope for the use of controlled-release fertilizers from available materials, on as wide a scale as possible in the ESCAP region, and particularly under flooded paddy conditions. As well as basic research, information should be collected and disseminated to interested governments and agricultural research and extension institutions. The International Fertilizer Development Centre of TVA might be requested to organize the proposed meeting to encourage the accelerated testing of promising materials under the wide range of conditions encountered by small farmers in Asia. It would be appropriate for the FAO, in co-operation with UNIDO and ESCAP, to co-ordinate these activities and help convene the meeting.

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Assistance to Country Programmes

318. As part of the follow-up activities to the UNIDO/ESCAP Priority Project, and following initiatives taken already to improve the effectiveness of existing fertilizer plant operations, there is a continuous need for co-operation between ESCAP countries and UNIDO. Existing fertilizer factories may need assistance to improve the on-stream factor and to modernize some of their production units. While most of the older small plants have already definite plans for debottlenecking, modernization or intensification, new problems may arise requiring the use of external or regional expertise. Some companies are not aware that UNIDO can provide assistance on a wide range of issues relating to the attainment of higher levels of technical knowledge on plant operations. It is therefore recommended that UNIDO and the regional commission's Secretariat should maintain contact with ESCAP member countries' governments to facilitate and speed-up requests prepared by countries and companies requiring assistance, and to help governments identify the need for such assistance. [Recommendation 22]

319. Under normal circumstances assistance would be organized within the existing UNIDO institutional framework, in co-operation with ESCAP member Governments and utilizing UNDP financial support. ESCAP might also play a role in identifying and supporting assistance projects, particularly where inter-country technical co-operation or factors relating to subregional economic co-operation may be involved, or where technical problems of fertilizer production are revealed in the course of its various activities affecting natural resources, trade, plan co-ordination, marketing and the utilization of agricultural requisites. One example of a possible opportunities for immediate technical assistance might be the suggestion that the Government of Afghanistan might request advisory services to assist it select appropriate technology, plant-size and general layout of its planned new factory. Other instances related to export which have been cited earlier are Singapore, Brunei and Burma, while country projects in Bangladesh, India, the Philippines and the Mekong riparian countries are not the less important for being part of possible subregional arrangements.

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320. A more substantial example not already mentioned may be the development of the fertilizer industry in Thailand, the existing situation of which calls for immediate action in order to elaborate a consistent trend in its future development. There is now one ammonia/urea unit based on lignite which has experienced severe difficulties since start-up and was operating in 1974 at about 24 per cent of its capacity. Major problems are experienced in the gasification of lignite, facilities for the various processes are ill-matched and maintenance has been neglected seriously. The unit could be reconstructed and brought to full capacity utilization but it will be necessary to consider whether supplementary investment for this purpose is justified, particularly in view of the establishment of a new ammonia/urea plant envisaged by the national plan and the recent discovery of natural gas to provide feedstock for it. Techno-economic assistance is required to support the consideration being given to this question by a Task Force set-up by the Government.

321. In 1970 recommendations on improvement of the old plant's operations were submitted by an external inspection team, but during the following years imported fertilizers were available in Thailand at considerably lower prices than the production cost the factory was able to attain, making the feasibility of supplementary investment and improvement of plant operations even more questionable. It remains to be seen whether efforts to expand output and reduce costs in the old plant are justified in the light of the higher fertilizer prices in recent years, the growth of local consumption, the discovery of natural gas in the Gulf, and the possibility of Thailand's participation in subregional co-operative arrangements through the development of potash deposits. Thus the development of the fertilizer industry in Thailand needs to be based on a thorough investigation of the relative feasibility of supplementary and new investment. Although some work is already in hand, it is recommended that an appraisal should be made of the techno-economic feasibility of reconstruction and debottlenecking of the existing ammonia/urea plant in Thailand [Recommendation 21(a)]; and that a pre-feasibility study should be conducted in the same country on the establishment of new production facilities for local supplies and possibly export. [Recommendation 21(b)]

322. The result of both studies should be combined to produce conclusions and recommendations for implementation by the Royal Thai Government. The

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project may conclude either that reconstruction and debottlenecking of the existing plant should be undertaken in the short run on a priority basis, with construction of a new plant later; or that the existing plant should be phased out and a new plant constructed if domestic and export demand for nitrogen warrant its addition to the region's facilities. Since the existing plant is at present unable to perform economically, the project should be endorsed and commenced as soon as possible. UNIDO might function as executing agency, while UNDP could provide finance for the project jointly with the Government. Since the plant was built by a consortium of German companies, it might be appropriate also to approach German financing institutions for assistance. The possibility of subcontracting the pre-feasibility study and/or follow-up projects for the redesign of the existing plant might be considered. The cost of the project and timing would need to be decided upon after discussion with the Government on the scope of assistance required for those parts of the two proposed studies not already in hand.

The Provision of External Finance

323. The ESCAP region as a whole will almost continuously be in deficit through to 1985 for phosphatic fertilizers, while a short period of surplus in nitrogenous fertilizers around 1980 is likely to have turned rapidly into a deficit of significant proportion by 1985 unless further investment is committed on a large scale. Although neither individual national deficits nor a regional deficit are necessarily inappropriate if adequate low-cost supplies are available elsewhere, almost all developing ESCAP countries with sizeable domestic consumption have definite production plans involving new investment in the 1980s in addition to that being undertaken during the 1975-1979 period. Apart from plans to produce for domestic markets, several countries which are well-endowed with the appropriate raw materials and nearby export markets in continuing fertilizer-deficit countries are planning the establishment of large capacities with a view to exporting substantial proportions of their output.

324. The latter trade-oriented approach at least should be encouraged since the optimum operational scale for ammonia and urea production is large. However, this scale requires a large investment -- about $US 200 million for a complex producing annually about 200,000 tons N or more based on natural gas. The cost would be about 30 per cent more than this if the plant were based on naphtha and 70 to 100 per cent more if based on coal. Economies of scale are

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less important in phosphatic fertilizer production, but phosphoric acid plants producing around 250 t.p.d. still cost around a substantial $ 40 million in 1975, including utilities. Investment decisions must continue to be taken on the basis of domestic consumption and export surplus estimates prepared up to 15 years in advance. The availability of financial resources is an important constraint on the industry's development, and the continuing pressure on restricted indigenous sources necessitates their being supplemented in large measure by international financial institutions.

325. Apart from the sheer size and long gestation periods of the investments, 70 per cent or more of the total cost of new plants in the developing countries of the region are in terms of foreign exchange, of which many of the countries concerned have severe shortages. In sum, the financing of a number of fertilizer projects in developing ESCAP countries remains a paramount concern, even where they are expected to be commercially viable, and assistance from international financial institutions is essential in view of the shortage of domestic financial resources and high foreign exchange component of plant costs. External financial support may be necessary also for increasing the growth rate of domestic fertilizer consumption in order to enhance the development of the industry and expand food output, and for avoiding or dealing with technical problems in production. It is therefore recommended that external financial resources made available to the ESCAP region should be directed especially towards large export-oriented plants, the utilization of local raw materials, the encouragement of domestic investment, the expansion of consumption, the remedying of faults and shortages causing low productivity, and the provision of technical assistance before and after start-up. [Recommendation 23] These six categories should receive priority attention in order to ensure that scarce resources are directed towards high productivity and low-costs in the industry, rather than its indiscriminate development on political grounds.

326. In the first place, the financing of large export-oriented plants is desirable in order to make full use of the natural assets available within the region and to take advantage of their location close to the fertilizer-deficit areas. It will not only provide fertilizers within the region but considerably promote the much needed improvement in the economic and financial conditions of these countries. As well as the plants themselves, the above-mentioned development of raw materials such as potash in Thailand, natural gas

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in Bangladesh, and rock phosphate in Afghanistan, India, Pakistan, Sri Lanka, should receive financial assistance in order to accelerate their utilization of these resources.

327. Certain developing countries have experienced increasing difficulty in raising adequate finance for meeting the local component of investment costs. One problem involved in relieving these difficulties, however, is that bringing in foreign exchange to meet such costs is likely to aggravate inflationary pressures if not offset by exports. This problem should be borne in mind by countries which prefer to obtain the money from external sources. Moreover it would be desirable for international financial institutions to help organize such funds locally, perhaps by under-writing their provision by local commercial banks and by encouraging local equity participation in fertilizer manufacturing.

328. As noted international financial assistance will be required in some countries in order to ensure the maintenance or increase of consumption growth rates. Support might be given particularly in the form of credit to be made available to the small farmer for investment in fertilizers for the period from planting to harvest. The growth in the use of fertilizers in a developing country is a function of a continuous generation of effective demand by farmers, the establishment of a proper marketing and distribution system and the continuous increase in the availability of fertilizer. The demand by the farmer for fertilizer depend on the benefits that he derives by using it and particularly on his perception of the cost/benefit ratio and the reliability of advice available on application procedures. In some cases there may be scope for international financial sources to help national governments formulate and implement appropriate policies with respect to:

(i) the pricing of fertilizer so that their prices do not hamper consumption;

(ii) the waiving of import duties on plant and equipment so that the final pricing of the fertilizer is more realistic; and

(iii) the announcement of support prices for farm produce well in advance to help the farmer to calculate how beneficial it would be for him to utilize the fertilizers on the basis of the likely return from doing so.

329. It is important that enough financial assistance should be available during the initial operational period of new plants. Most developing countries in the region require technical assistance not only in the stages of designing, erection and plant commissioning, but also in the early years of operation. Therefore, provisions for obtaining such services from overseas licencors or other fertilizer manufacturers from within or outside the region, should be encouraged and included in cost estimates and loans. Furthermore, the financing of the acquisition of spare parts, debottlenecking and modernization activities should receive emphasis in the allocations of lending institutions. In particular the IBRD should consider short circuiting the normal procedures for providing limited loans for spare parts supplies, debottlenecking, modernization of existing plants and for emergencies, in order to maintain high productivity of plant operations.

330. With respect to repayment terms, it appears that the present three years' moratorium for tied loans is inadequate, since a new plant cannot begin to earn profit within the first three years of the grant of loan. More appropriate terms would be a four-year period of moratorium and a total payment period of 14 years. It is recommended that more moderate repayment terms should be adopted for loans to construct new facilities in developing ESCAP countries, and extensive co-ordination should occur among various regional and external funding institutions. [Recommendation 24] It is noted that the International Fund for Agricultural Development (IFAD) has been empowered to provide loans for the establishment of fertilizer plants, the procurement of equipment, and the organization of distribution infrastructure. The Asian Development Bank also is expanding its interest in fertilizer investment, and close co-ordination of financial aid granted by various funding institutions should be initiated by the IBRD, which will remain the major source of finance. ESCAP and other non-funding agencies also should support this co-ordination process, and help member countries identify appropriate sources and terms of external investment, particularly that generated within the region.

/ANNEXES

ANNEXES

Annex I: Tables Cited in the Text

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Page

/Table 1.

Table 1. Fertilizer consumption per hectare and per capita in the ESCAP region, 1973/74

(kg/hectare)

	Per hectare of arable and agricultural land								Per capita
	N		P_2O_5		K_2O		All nutrients		All nutrients
	A_1	A_2	A_1	A_2	A_1	A_2	A_1	A_2	
Africa	5.3	1.1	3.4	0.7	1.5	0.3	10.2	2.1	5.8
North and Central America	35.6	15.5	19.9	8.7	18.5	8.1	74.0	32.3	60.3
South America	9.7	1.3	11.7	2.2	7.4	1.4	28.8	5.4	12.5
Europe	78.3	48.5	60.9	37.7	66.6	37.5	199.7	123.8	60.9
Oceania	4.6	0.4	34.3	3.2	6.1	0.6	45.0	4.1	104.0
USSR	27.0	7.2	11.6	3.1	15.5	4.1	54.1	14.4	50.3
Asia	19.5	9.2	8.5	4.0	4.3	2.1	32.3	15.2	7.1
Afghanistan	3.8	2.2	0.9	0.5	0.0	0.0	4.7	2.7	2.0
Bangladesh	13.4	12.6	4.8	4.5	1.2	1.1	19.4	18.2	2.1
Burma	2.2	2.2	0.8	0.8	0.0	0.0	3.0	2.9	1.9
Cambodia	0.5	0.4	0.5	0.4	0.0	0.0	1.1	0.8	0.3
China	30.0	11.7	10.9	4.2	4.2	1.6	45.1	17.5	7.0
India	11.1	10.3	3.8	3.6	1.9	1.8	16.9	15.6	4.8
Indonesia	19.3	12.5	4.7	3.0	2.2	1.4	26.3	17.0	3.6
Iran	10.9	6.5	7.1	4.2	0.1	0.0	18.1	10.7	9.4
Japan	155.0	144.4	149.7	139.5	129.3	120.5	434.1	404.4	21.4
DPR of Korea	126.7	123.5	59.2	57.7	23.4	22.8	209.4	204.0	26.3
Rep. of Korea	172.3	171.0	82.1	81.5	62.8	62.3	317.2	314.8	21.9
Laos	0.1	0.1	0.1	0.1	0.0	0.0	0.2	0.1	0.1
Malaysia (West)	37.1	36.7	12.0	11.9	36.7	36.3	85.8	84.9	24.7
Mongolia	1.9	0.0	4.9	0.0	0.1	0.0	7.0	0.0	3.9
Nepal	4.5	3.0	2.2	1.5	0.3	0.2	7.1	4.7	1.2
Pakistan	17.6	14.0	3.0	2.4	0.1	0.1	20.8	16.5	5.9
Philippines	13.1	12.2	4.1	3.8	4.0	3.7	21.2	19.7	5.6
Sri Lanka	25.9	21.2	6.1	5.0	16.0	13.1	47.9	39.2	7.0
Thailand	5.0	4.9	3.2	3.1	2.9	2.8	11.1	10.9	3.9
DR of Viet-Nam	7.4	3.7	24.8	12.4	2.7	1.3	34.8	17.5	3.1
South Viet-Nam, Rep. of	33.9	17.8	10.4	5.5	5.5	2.9	49.8	26.2	8.5

Source: FAO: Annual Fertilizer Review, 1974.

Note: A_1 denotes arable land; A_2 denotes agricultural land.

/Table 2.

Table 2. Imports of nitrogenous fertilizers in the ESCAP region, by importing and exporting countries, 1973

(thousand tons of product)

Importers \ Exporters	All OECD Countries	USA	Japan	Fed. Rep. of Germany	Belgium	Nether-lands	Italy	France
World	12,377	929	3,454	1,294	1,416	2,564	1,040	540
OECD	2,793	91	5	716	838	948	96	269
Socialist group (excluding China)	48	...	...	1	...	30	1	...
Africa	825	1	...	69	193	228	102	204
Latin America	1,219	302	17	240	167	443	19	28
Asia	5,452	234	3,253	194	120	657	778	33
Afghanistan	15	12	...	1	...	...	...	...
China	2,458	...	1,926	2	61	94	304	25
Hong Kong	5	...	3	...	...	...	...	...
India	704	...	465	61	11	92	65	...
Indonesia	410	23	325	...	...	62	...	...
Iran	1	...	...	...	...	...	...	1
Japan	12	10	...	...	...	2	...	...
Malaysia	62	...	27	23	2	2	...	...
Nepal	30	...	25	5	...	...	...	...
Pakistan	156	16	38	...	...	102	...	...
Philippines	299	...	267	...	7	6	...	...
Rep. of Korea	9	...	9	...	...	...	...	...
Rep. of South Viet-Nam	181	180	...	1	...	...	...	...
Singapore	86	51	28	7	...	...	...	...
Sri Lanka	110	...	98	1	...	11	...	...
Thailand	55	1	35	13	...	6	...	...

Source: World Trade Annual, 1973, vol. II, p. 284.

/Table 3.

Table 3. Imports of phosphatic fertilizers in the ESCAP region, by importing and exporting countries, 1973 and 1974

(in thousand tons of product)

Importers \ Exporters	All OECD Countries	USA	Israel	Japan	Belgium	France
(1) 1973						
World	4,224	873	244	37	1,282	307
OECD	2,920	130	101	2	1,911	273
Socialist group (excluding China)	188	...	81	...	1	23
Africa	83	38	12	...	15	7
Latin America	464	413	...	1	23	...
Asia	446	251	39	24	19	...
Bangladesh	53	37	...	...	...	...
China	81	...	...	2	15	...
Hong Kong	9	1	8	...	...	...
Indonesia	25	20	...	5	...	...
Japan	23	23	...	...	...	...
Malaysia	3	...	...	...	1	...
Philippines	1	...	...	1	...	...
Republic of Korea	77	74	...	3	...	...
Singapore	91	91	...	...	...	...
Sri Lanka	14	5	...	6	1	...
Thailand	3	...	...	1	2	...

(2) 1974	Jordan	USA	Morocco	Israel	Other	Total
Asia	896.2	3,497.4	1,203.5	18.2	1,962.3	7,678.3
Bangladesh	...	...	86.4	...	...	86.4
Cambodia	2.5	...	...	...	...	2.5
China	...	40.3	222.0	...	919.9	1,182.2
India	549.0	252.6	263.7	...	11.5	1,077.0
Indonesia	...	...	...	...	24.0	24.0
Iran	13.7	398.6	...	...	...	412.3
Japan	258.4	2,262.0	631.2	18.1	678.1	3,847.8
DPR of Korea	...	....	...	...	19.0	19.0
Rep. of Korea	10.1	504.5	...	...	165.3	679.9
Malaysia & Singapore	16.8	...	...	0.5	144.5	161.8
Pakistan	43.2	...	...	...	...	43.2
Philippines	...	139.4	...	...	...	139.4
Sri Lanka	2.5	...	...	...	...	2.5
Thailand	...	...	...	0.3	...	0.3

Sources: (1) World Trade Ann. , 1973, vol. II, pp. 284-285.
(2) FAO: Monthly Bulletin of Agricultural Economics and Statistics, June 1975.

/Table 4.

Table 4. Exports of potash fertilizers in the ESCAP region, by importing and exporting countries, 1973

(in thousand tons of product)

Importers \ Exporters	All OECD Countries	USA	France	Canada	Belgium	Federal Rep. of Germany
World	12,234	1,426	700	7,129	528	2,103
OECD	8,469	204	462	5,705	375	1,345
Socialist group (excluding China)	197	...	...	...	...	197
Africa	278	...	10	5	35	131
Latin America	828	513	...	147	29	112
Asia	1,898	286	21	1,238	78	258
Bangladesh	22	...	...	20	...	2
China	77	...	...	53	13	...
India	319	...	...	216	5	98
Indonesia	25	...	4	...	6	15
Japan	922	164	...	602	48	104
Malaysia	1	...	...	...	...	1
Nepal	7	...	...	...	5	2
Pakistan	11	...	...	...	...	11
Philippines	57	17	...	37	...	3
Rep. of Korea	219	20	...	198	...	...
Singapore	84	4	...	80	...	...
South Viet-Nam	17	17	...	...	...	...
Sri Lanka	37	...	17	...	...	20
Thailand	3	...	...	...	1	2
Other Asia, nes.	96	64	...	32	...	...

Source: World Trade Annual, 1973, vol. IX, pp. 285-286.

/Table 5.

Table 5. Imports of fertilizer and balances of trade in developing ESCAP countries, 1973 and 1974

(in million US dollars)

Country	Fertilizer Imports		Balance of Trade	
	Actual 1973	Estimated 1974	1973	1974
Afghanistan	6.3	17.7	-32	-33
Bangladesh[a/]	20.9	52.7	-268	-600
Cambodia	0.8	1.3	-235	-437
Fiji	2.8	2.8	-125	-105
Hong Kong	1.4	1.7	-586	-803
India[b/]	294.6	439.3	-278	-942
Laos	0.1	0.1	-52	-74
Nepal	0.5	0.5	-52	-57
Pakistan	26.3	36.5	-20	-596
Philippines	14.8	83.7	113	-744
Republic of Korea	n.a.	n.a.	-1,019	-2,384
Singapore	32.2	62.6	-1,453	-2,552
South Viet-Nam	36.3	61.9	-561	-659
Sri Lanka	17.2	34.4	-33	-160
Thailand	56.1	69.9	-473	-699
Tonga	-	-	-7	-5
Western Samoa	-	-	-13	-14
Sub-total, trade deficit countries	510.3	915.6	-5,099	-10,864
British Solomon Is.	-	-	-3	5
Burma	1.3	3.5	26	130
Gilbert and Ellice Is.	-	-	9	24
Indonesia	153.3	328.0	865	3,485
Malaysia	27.4	64.4	548	75
Papua New Guinea	1.0	1.4	195	330
Sub-total, trade surplus countries	183.	397.	1,639	4,049
Total, 23 ESCAP Countries	693.	1, .	-3,460	-6,815

Source: Asian Development Bank, The Annual Report, 1974, Manila, 1975.

Notes: a/ As of 30 June.
b/ As of 31 March.

/Table 6.

Table 6. Potential exports of nitrogenous fertilizers by major exporting regions or countries, 1975-[illegible]

('000 metric tons N)

	North America	Western Europe	Eastern Europe & USSR	Japan	Israel	South Africa	Oceania
1975	239 (200)	2,7[illegible] (1,800)	[illegible]05 (900)	2,531 (1,500)	1[illegible]	[illegible]	-51 (-)
					----------------	----------------	
1976	-18 (500)	2,542 (1,800)	1,1[illegible] (1,[illegible])	2,528 (1,500)	[illegible]	221	-[illegible] (-100)
					----------------	----------------	
1977	-3[illegible] (1,600)	2,485 (1,700)	[illegible] ([illegible]00)	[illegible],52[illegible] (1,500)	[illegible]	[illegible]	-80 (-)
					----------------	----------------	
1978	-238 (1,500)	2,310 (1,700)	1[illegible] (400)	2,531 (1,400)	[illegible]	214	-95 (-)
					----------------	----------------	
1979	(1,200)	(1,[illegible]00)	([illegible]00)	(1,[illegible])	----------------	----------------	(-)
1980	(900)	(1,700)	([illegible])	(1,2[illegible])	----------------	----------------	(-)

Sources: TVA: World Fertilizer Market Review and Outlook, 1974, p. 42; and FAO: Long-term Fertilizer Supply/Demand Positions and Elements of a World Fertilizer Policy, Table 2, p. 22

Note: The figures in [illegible] are [illegible] estimated by the FAO/UNIDO/World Bank Working Group. The [illegible] figures [illegible] represent the "high" estimates by TVA rather than the "maximum" or "low" ones.

Table 7. Potential exports of phosphatic fertilizers by major exporting regions and countries, 1975-1980

('0[illegible] [illegible]ric to[illegible] P_2O_5)

	North America	Western Europe	Eastern Europe & USSR	Japan	Israel	Oceania	Developing Africa
1975	2,001 (1,910)	562 (590)	2,5[illegible] (1,130)	1[illegible]	7[illegible]	34 (-120)	[illegible] (730)
				-----(80)-----			
1976	2,397 (2,100)	[illegible] ([illegible])	2,[illegible] (800)	1[illegible]	123	52 (-20)	957 (1,040)
				----(1[illegible])-----			
1977	2,276 (2,020)	712 (240)	2,[illegible] ([illegible]00)	1[illegible]	183	[illegible] (-20)	983 (1,470)
				----(21[illegible])-----			
1978	2,218 (1,870)	492 (550)	2,[illegible] ([illegible])	164	190	89 (-120)	1,181 (1,620)
				-----([illegible])-----			
1979	(1,[illegible]10)	([illegible])	(-[illegible])	----([illegible])-----		(-120)	(1,770)
1980	(1,7[illegible])	([illegible])	(-7[illegible])	----([illegible])-----		(-220)	(1,730)

Sources: TVA: ibid., p. 4[illegible]; [illegible] FAO: ibid., Table [illegible], pp. 23-24

Note: See Table 6.

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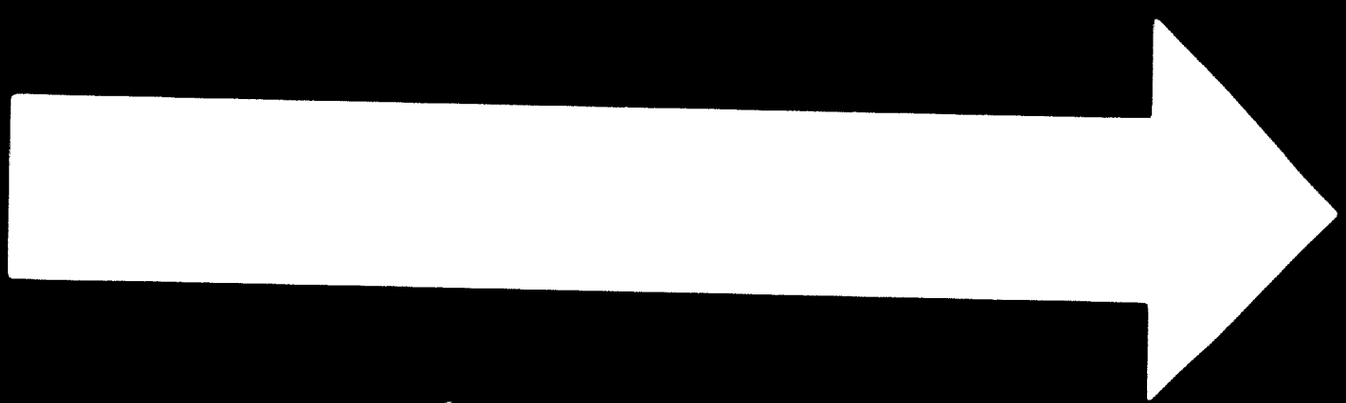

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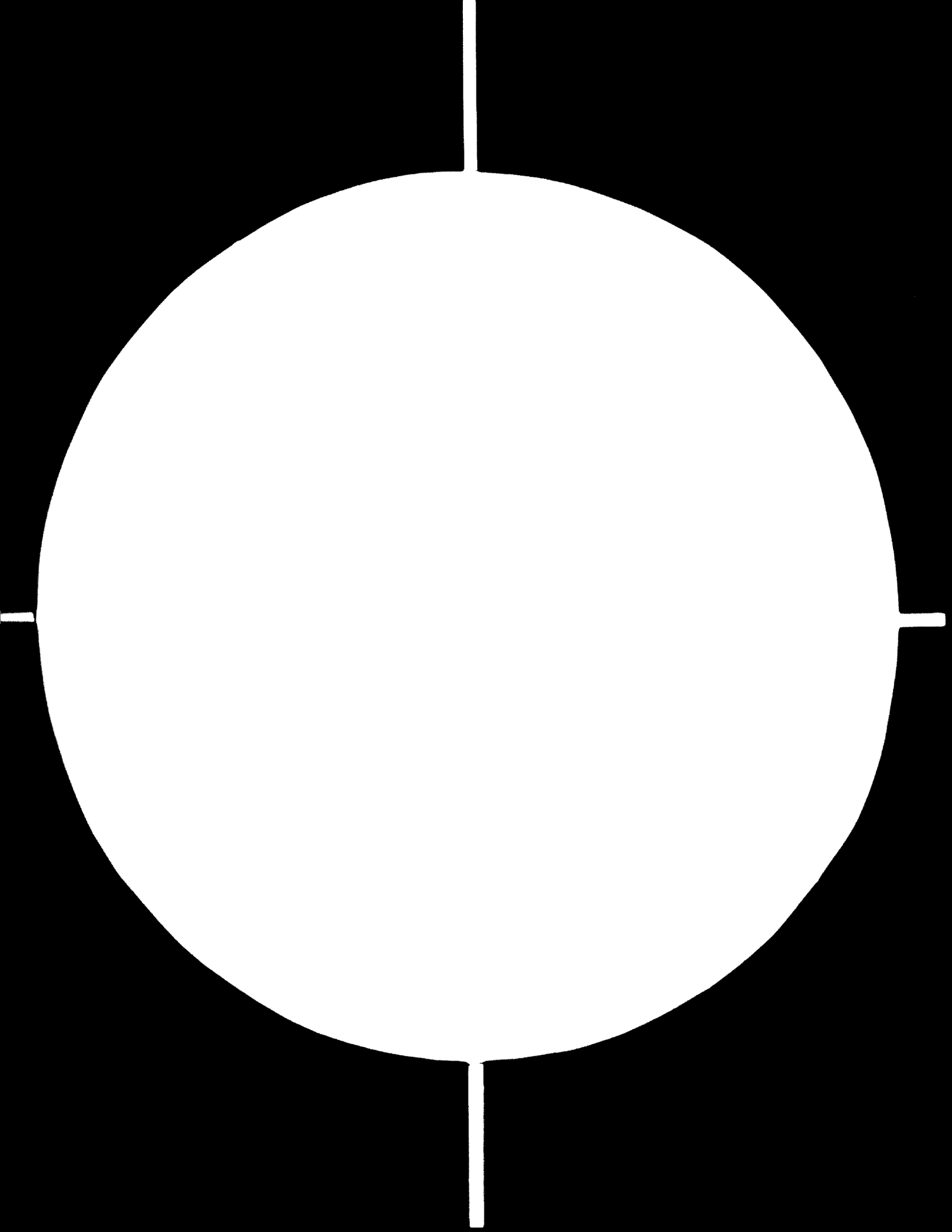


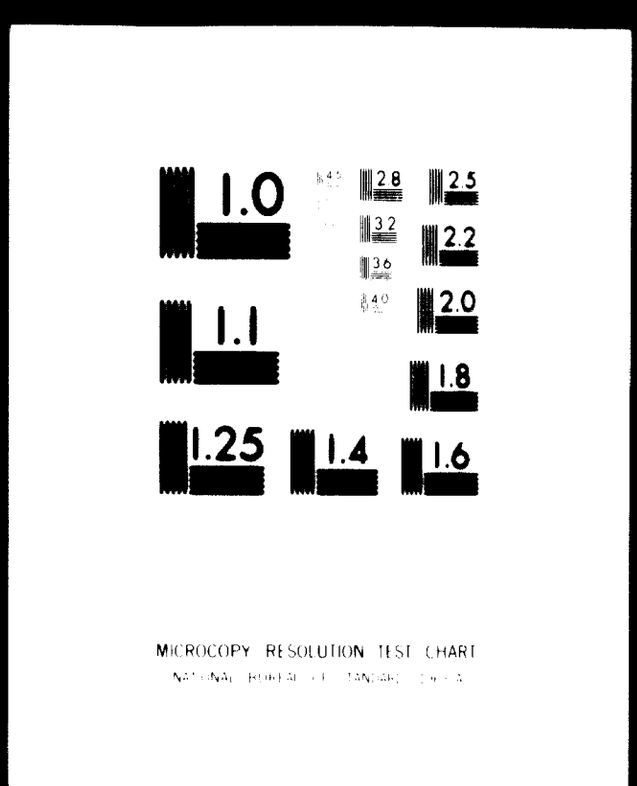


Table 8. Potential exports of potash fertilizers by major exporting regions and countries, 1975-1980

(in thousand metric tons K_2O)

	North America	Western Europe	Eastern Europe & USSR	Israel	Developing Africa	Developing Asia
1975	8,249 (2,700)	5,516 (-)	7,370 (2,000)	667	339 (60)	102 (-1,000)
1976	8,249 (2,900)	5,764 (100)	7,881 (3,050)	667	339 (30)	102 (-1,200)
1977	8,249 (3,000)	5,874 (-)	[illegible]	667	339 (20)	102 (-1,300)
1978	8,249 (3,100)	5,874 (100)	8,891 (3,400)	667	[illegible] [illegible])	102 (-1,400)
1979	(2,[illegible])	(200)	(3,950)		[illegible])	(-1,500)
1980	(2,600)	(100)	(4,650)		(-110)	(-1,600)

Sources: TVA; ibid., [illegible] and [illegible]., table 4, p. 25.

Note: See table 6.

/Table 9.

Table 9. Fertilizers supplied under the IFSS and utilization of resources for developing ESCAP recipients, 1974/75

(in $US '000 and tons)

Country	1.Supply of cash and fertilizers				2.Utilization of resources		
	Cash ($US'000)	TSP (tons)	Urea (tons)	Compound (tons)	Programmed ($US'000)	Processed ($US'000)	Completed ($US'000)
Afghanistan	800	-	-	-	-	-	-
Bangladesh	-	11,000	25,000	-	-	6,186	3,775
India	-	-	20,500	7,350	-	-	11,347
Laos	-	-	-	-	-	90	-
Nepal	-	-	2,000	-	-	-	1,160
Pakistan	-	-	-	14,000 (20-20-0)	-	4,514	-
Sri Lanka	-	-	5,000	-	-	-	2,000
Tonga and others	-	-	1,118	300 (12-6-[illegible])	270	-	-
Western Samoa	-	-	41	700 (12-6-2[illegible])	-	-	-

Sources: 1. Mission C for RAS/74/045 [illegible]

2. FAO, Report on International Fertilizer Supply Scheme, document submitted to Committee on Fertilizers, second session, Rome, 3-7 June 1975.

/Table 10.

Table 10. Suppliers' credit and long-term loans on fertilizer plant and equipment in selected developing ESCAP countries, 1961-1978

(value in $US million or DM million)

Country	Total World Bank Group ($US m)	Total Asian Development Bank ($US m)	Japan ($US m)	United States ($US m)	Fed. Rep. of Germany (DM m)
Bangladesh	33.0	30	87.0	30.0	30.0
Burma		-	10.0		50.0
India	366.4	..	94.0	58.0	40.0 a/
Indonesia	180.0	10	9.0	24.0	-
Pakistan	70.8	27	11.0		-
Rep. of Korea			3.0	53.8	
Sri Lanka		30	0.864		90..
Thailand		-	0.638		66.0
Total	622.3	97	215.502	165.8	236.8

Sources: United States Government; AID working papers; Japanese Government; Ministry of International Trade and Industry working papers; and Government of the Federal Republic of Germany; BMZ working papers.

Note: a/ An additional DM 110-150 million loans is currently planned for India.

/Table 11.

Table 11. Estimated Nitrogen Consumption in 11 ESCAP Countries, 1973/74 and 1974/75 ('000 tons N)

	1973/74					1974/75					Anticipated growth rates a/	
	TVA/IFDC 1/			UNIDO/ ESCAP 2/	FAO 3/	TVA/IFDC 1/			UNDP/ESCAP 2/		TVA/ IFDC	UNIDO/ ESCAP
	High	Mid	Low	PM		High	Mid	Low	PM	APM	Mid	EG
Afghanistan	21	16	12	23	30	23	18	13	26		8.4	9.6
Bangladesh	129	90	52	103	122	140	[illegible]	60	138		10.8	8.9
India	2,139	2,139	2,139	1,837	1,835	2,396	2,396	2,396	2,160		10.6	11.7
Indonesia	348	303	258	n.a.	350	404	343	282	462	432	11.6	11.3
Iran	138	131	12[illegible]	197	177	162	152	142	269		13.8	16.8
Malaysia	90	85	80	n.a.	113	[illegible]	[illegible]	86	91		8.4	3.6
Pakistan	451	423	[illegible]	442	342	[illegible]	[illegible]	[illegible]	471		10.2	15.9
Philippines	152	141	130	n.a.	146	[illegible]	[illegible]	141	238	147	9.6	16.9
Rep. of Korea	431	406	381	n.a.	411	[illegible]	434	400	510	439	[illegible]	[illegible].0
Sri Lanka	62	56	[illegible]	[illegible]	51	[illegible]	58	5[illegible]	[illegible]		[illegible]	[illegible].8
Thailand	78	69	[illegible]	n.a.	70	[illegible]	[illegible]	[illegible]	[illegible]	73	[illegible]	[illegible]
ASEAN	668	600	528	n.a.	681	757	[illegible]	57[illegible]	[illegible]	743	10[illegible]	[illegible].2
Non-ASEAN	3,371	3,260	3,152	n.a.	2,967	3,764	[illegible]	3,498	3,65[illegible]	[illegible]80	[illegible].1	11.6
11 Countries	4,039	3,860	3,680	n.a.	3,648	4,521	4,297	4,072	4,492	4,323	10.1	11.5

Sources: 1/ TVA, International Fertilizer Development Centre: An Appraisal of the Fertilizer Mar[illegible] and Trends in Asia, Muscle Shoals, June 1975; Appendix table A-4.

2/ UNIDO/ESCAP Priority Project: Reports of Missions A and B (paper A.IV page 11, and B.I page 13); PM denotes figures collected from country sources during the project missions; APM denotes project mission figures amended in the light of other considerations.

3/ Food and Agricultural Organization: 1974 Annual Fertilizer Review, table 11, pages 98-100.

Note: a/ Annual growth rates expected over the six years 1973/74 to 1979/80, comparing (a) TVA/IFDC mid-point figures and (b) FAO and Expert Group figures. (See table 12.)

/Table 12.

Table 12: Projected nitrogen consumption in 11 ESCAP countries, 1979/80, 1984/85, 1989/90 ('000 tons N)

	1979/80						1984/85			1989/90		
	TVA/IFDC 1/			UNIDO/ ESCAP 2/	RE 3/	Mean 4/	UNIDO/ ESCAP	RE	Mean	UNIDO/ ESCAP	RE	Mean
	High	Mid	Low	EGM	LSQ	(High Low)	EGM	LSQ	(High Low)	EG	LSQ	(High Low)
Afghanistan	32	26	20	52	62	41	83	105	94	130	142	136
Bangladesh	216	167	118	203	228	173	298	328	313	438	446	442
India	3,915	3,915	[illegible], 15	3,573	3,583	3,744	6,296	5,212	5,754	11,096	7,145	9,120
Indonesia	765	587	409	665	471	587	933	666	800	1,310	895	1,120
Iran	315	285	255	449	283	352	472	445	458	495	643	568
Malaysia	157	138	119	139	147	138	215	206	210	302	275	288
Pakistan	867	756	645	831	769	756	1,1[illegible]	1,138	1,165	1,522	1,580	1,551
Philippines	290	245	200	37[illegible]	209	286	6[illegible]	283	441	512	368	440
Rep.of Korea	700	600	5[illegible]	515	342	521	613	456	534	724	585	654
Sri Lanka	74	66	5[illegible]	111	63	84	138	71	[illegible]04	183	79	131
Thailand	110	99	88	113	108	100	176	151	[illegible]63	[illegible]73	202	237
ASEAN	1,322	1,069	816	1,291	936	1,111	1,92[illegible]	1,307	1,615	[illegible],398	1,741	2,069
Non-ASEAN	6,119	5,815	5,511	5,737	[illegible],330	5,671	9,093	7,755	8,424	14,587	[illegible]0,619	12,604
11 Countries	7,441	6,884	6,327	7,028	[illegible],266	6,782	11,018	9,062	10,040	16,985	[illegible]2,360	14,673

Sources: 1/ TVA, International Fertilizer Development Centre: An Appraisal of the Fertil[illegible] Market and Trends in Asia, Muscle Shoals, June 1975; Appendix table A-4.

2/ UNIDO/ESCAP Priority Project: Report of the Expert Group, Bangkok, July 1975; tables 4 and 6, pages 15 and 18, based on Reports of Missions A and B and incorporating the revisions to the following project mission figures for 1979/80 and 1984/85 respectively: Indonesia 800, 1,385; Philippines 381 or 237, 610 or 348; the Republic of Korea 608, 725; Thailand 78, 121.

3/ Raymond Ewell: unpublished least-squares exercises based on best straight line 1963-74; correspondence with ESCAP, November 1975.

4/ Mean represents the arithmetic mean of the highest and lowest of all other projections for each country, including the amended (but not original) UNIDO/ESCAP project mission figures.

/Table 13.

Table 13. Estimated and projected phosphate consumption of 11 ESCAP countries, 1973/74, 1979/80, 1984/85 and 1989/90

(In thousand tons P_2O_5)

	Estimate 1/ 1973/74	Projections 2/			
		Growth rate	1979/80	1984/85	1989/90
Afghanistan	7	21.9	23	37	58
Bangladesh	44	9.8	77	121	190
India	600	11.3	1,235	2,176	3,836
Indonesia	85	14.5	192	330	544
Iran	174	[illegible]	307	323	339
Malaysia	[illegible]	[illegible]	96	135	190
Pakistan	98	20.8	232	333	425
Philippines	45	[illegible]	118	191	212
Rep. of Korea	1	[illegible]	205	365	468
Sri Lanka	12	[illegible]	50	62	94
Thailand	45	[illegible]	104	161	250
ASEAN	[illegible]	15.3	510	825	1,196
Non-ASEAN	1,[illegible]	12.7	2,209	3,417	5,410
11 countries	[illegible]	13.2	2,719	4,242	6,606

Sources: 1/ 1973/74: FAO Statistical [illegible]
2/ Projections: [illegible] ESCAP [illegible] Group.

/Table 14.

Table 14. Nitrogen and phosphate production capacities, output, shares of domestic markets and capacity-utilization rates in 10 ESCAP countries, end 1974, 1973/74 or calendar 1974

(in thousand tons N or P_2O_5 and per cent)

	Nitrogen					Phosphate				
	('000 tons N)			(per cent)		('000 tons P_2O_5)			(per cent)	
	Capacity end-1974	Output 1973/74	Output calendar 1974	Utilization of end-1974 capacity	Shares of market	Capacity end-1974	Output 1973/74	Output calendar 1974	Utilization of end 1974 capacity	Shares of market
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
Afghanistan	49	...	8	...	...	...	...	...a/	...a/	...
Bangladesh	212	129	95	98	106	49	..	...a/	...a/	...
India	2,153	1,050	1,115	52	38	655	5	316	48	50
Indonesia	273	91	141	52	26	...	...	...	...	...
Iran	157	43	43	90	81	100	74	99	99	55
Malaysia	44	3	42	95	35	...	...	...	...	...
Pakistan	313	3	300	96	8	10	4	4	40	7
Philippines	114	7	59	51	40	78	42	46	58	93
Rep. of Korea	543	67	7	94	109	147	159	162	110	81
Thailand	26	8		24	1	...	...	...	...	...
ASEAN		204	248	84	30	78	42	46	58	20
Non-ASEAN	3,427	2,070	2,152	63	70	964	562	570	59	52
10 countries	3,864	2,274	2,400	62	62	1,042	604	616	59	47

Sources: (1) Capacity, end-1974: UNIDO/ESCAP project missions;
(2) Output, 1973/74 fertilizer year: FAO statistical tables;
(3) Output, calendar 1974: UNIDO/ESCAP project missions.
(4) Utilization of capacity rates are the ratios of column (3) to column (1).
(5) "Shares of market" are the ratios of domestic consumption in 1973/74 (tables 11 and 13) to column (2).

a/ Nil until September 1974.

/Table 15.

Table 15. Plant composition of new capacity expected to come on-stream in 11 ESCAP countries in the 1975-1979 period

(tons of nutrient)

		N	P_2O_5
Afghanistan:	Expansion of existing plant	80,000	...
Bangladesh:	Ashuganj plant	243,000	...
India:	Namrup II	152,000	...
	Barauni plant	152,000	...
	Tuticorin plant	258,000	51,000
	Talcher plant	228,000	...
	Ramagundan plant	228,000	...
	Haldia plant	152,000	75,000
	Nangal II	152,000	...
	Bhatinda plant	235,000	...
	Panipat plant	235,000	...
	Mangalore plant	160,000	...
	Phulpur plant	228,000	...
	Maharashtra Co-op.	51,000	...
	Cochin expansion	40,000	114,000
	Sindri expansion	129,000	156,000
	Hindustan Copper	...	90,000
	Hindustan Zinc	...	30,000
	Karnataka State	...	83,000
	Other expansion	181,000	151,000
		2,581,000	750,000
Iran:	Shiraz expansion	309,000	...
	Bandar Shapur expansion	252,000	221,000
		561,000	221,000
Pakistan:	Pak.-Arab, Multan	242,000	71,000
	Fauji-Agrico.	266,000	...
	NFC, Mirpur	266,000	...
	NFC, Hazara	...[a/]	90,000[a/]
	NFC, Lyallpur	...	9,000
		774,000	170,000
Sri Lanka:	State Fertilizer Corp.	143,000	56,000
Rep. of Korea:	Several expansions (no new plant on stream)	110,000	50,000
Malaysia:		---No expansion[b/]---	

/**Indonesia:**

Table 15. (continued)

		N	P_2O_5
Indonesia:	Pusri III	262,000	...
	Kalimantan I	262,000	...
	W. Java plant	262,000	...
		786,000	...
Philippines:	Atlas, Luzon	56,000	72,000
Thailand:		---No expansion[b/]---	
Total ASEAN		842,000	72,000
Total Non-ASEAN		4,492,000	1,247,000
Total 11 Countries		5,334,000	1,319,000

Source: UNIDO/ESCAP Priority Project field-missions, May 1975.

Notes: a/ A project finalized since the field-mission to Pakistan, not included here, will have capacity to produce 46,000 tons N in the form of urea and MAP at Haripur, Hazara. Another small plant near Karachi will recover ammonium sulphate with 4,000 tons N capacity.

b/ However recent reports suggest that plants in Sarawak and Songkhla are under construction.

/Table 16.

Table 16. Nitrogen and phosphate capacities and production in 1979/80 in 11 ESCAP countries

('000 tons of nutrient)

	Nitrogen (N)				Phosphate (P_2O_5)			
	New a/ capacity 1975-79	Capacity b/ end-1979	Production 1979/80	Assumed operating rate (%)	New a/ capacity 1975-79	Capacity b/ end-1979	Production 1979/80	Assumed operating rate (%)
Afghanistan	80	129	103	(80)	...	...	...	...
Bangladesh	243	[illegible]	364	(80)	...	50	35	(70)
India	2,581	[illegible]	3,787	(80)	750	1,405	983	(70)
Indonesia	786	[illegible]	847	(80)	...	...	...	...
Iran	561	718	646	(90)	221	323	226	(70)
Rep. of Korea	110	653	588	(90)	50	197	177	(90)
Malaysia	-	44	40	(90)	...	...	...	...
Pakistan	774	1,087	978	(90)	170	180	126	(70)
Philippines	56	170	136	(80)	72	150	105	(70)
Sri Lanka	143	143	114	(80)	56	56	39	(70)
Thailand	-	26	13	(50)	...	...	...	...
ASEAN	842	1,299	1,036	(80)	72	150	105	(70)
Non-ASEAN	4,492	7,919	6,580	(83)	1,247	2,211	1,586	(72)
Total	5,334	9,218	7,616	(82)	1,319	2,361	1,691	(72)

Source: UNIDO/ESCAP Expert Group, based on mission reports of official sources and discussions with governments. The Indonesian nitrogen figures were supplied by one of the experts.

Notes: a/ See table 15 for composition.

b/ Capacity at end-1979 for each country is the sum of the previous column figure and the existing capacity at the beginning of 1975 reported in table 14.

/Table 17.

Table 17. Nitrogen production by feedstock requirements for ammonia plants in 11 ESCAP countries a/, to 1985

('000 tons N and per cent of total)

	Total	Natural gas	Naphtha	Fuel oil	Coal	Hydro power	Refinery gas	Others
Existing plants	3,880 (100)	1,212 (31)	2,134 (55)	52 (1)	216 (6)	80 (2)	70 (2)	116 (3)
New capacity 1975-1979	5,334 (100)	2,507 (47)	1,014 (19)	1,173 (22)	480 (9)	- (-)	- (-)	160 (3)
New capacity 1980-1985 b/	3,552 (100)	1,200 (34)	224 (6)	1,900 (53)	228 (6)	- (-)	- (-)	- (-)
Total (1985)	12,766 (100)	4,919 (39)	3,372 (26)	3,125 (24)	924 (7)	80 (1)	70 (1)	276 (2)

Notes:

a/ Afghanistan, Bangladesh, India, Indonesia, Iran, Republic of Korea, Malaysia, Pakistan, Philippines, Sri Lanka, and Thailand.

b/ 1980-1985 capacity figures are partial, representing those which are presently planned.

Table 18. Equivalent prices of various hydrocarbon feedstocks in terms of their relative energy (BTU) content

Gas	Naphtha	Fuel oil	Coal
($/1,000 ft^3)	($/mt)	($/bbl)	($/mt)
3.00	130	16	40
2.55	110	14	34
2.05	90	12	27
1.85	0	10	25

Source: Extrapolated from TVA/IFDC, op. cit. (Indonesia), pp. 39-42.

/Table 19.

Table 19. Illustrative comparisons of sea freight and insurance costs and their effect on landed prices of bagged urea produced in various locations (in $US per ton urea)

Location	Feedstock	Plant	Sale gate price	Freight cost to S.E. Asia	Freight cost to Bombay	Price in S.E. Asia	Price in Bombay
US (east)	High-cost gas	New 1978	169	90	80	259	249
Domestic	$100 naphtha	New 1978	246	-	-	246	246
Iraq	Low-cost gas	New 1978	179	32	18	211	197
Pakistan	Low-cost gas	New 1978	179	23	n.a.	202	n.a.
Domestic	Low-cost gas	New 1978	179	-	-	179	179
Japan	$90 fuel oil	Existing	114	23	45	137	159

Source: Derived from figures in TVA/IFDC: op.cit. (Appraisal), tables 44, 45, 47, 49, pp. 82-3 and 86-7; and op.cit. (Indonesia), table 41, p. 55.

Note: Bulk freight rates would be about two-thirds of bagged levels.
n.a. denotes 'not available.'

Table 20. Illustrative comparisons of impact on price of N caused by shipping feedstocks, intermediates or products at hypothetical freight rates (in $US per ton)

Item shipped	Feedstock cost per ton of item F.O.B.	Freight	C.I.F.	Feedstock cost per ton of N F.O.B.	Freight	Total
LNG[a/]	0.45	0.55	1.00	17	21	38
	0.45	2.00	2.45	17	77	94
Fuel oil	50	11	61	63	13	76
	50	70	120	63	87	150
Naphtha	110	11	120	128	13	141
	110	70	180	128	72	200
Ammonia ex 45c gas		11	n.a.	17	14	31
		70	n.a.	17	89	106
Ammonia ex $50 f/oil		11	n.a.	63	15	78
		70	n.a.	63	88	151
Urea ex 45c gas		11	n.a.	17	24	41
		70	n.a.	17	152	169
Urea ex $50 f/oil		11	n.a.	63	23	86
		70	n.a.	63	151	214

Source: Derived from TVA/IFDC, op.cit. (various reports).

Note: a/ Feedstock cost expressed per 1000 ft^3 of gas and per ton N.

/Table 21.

Table 21. Supply-demand balances for nitrogen in 11 ESCAP countries estimated for in 1973/74 and expected in 1979/80.

(in '000 tons N)

	1973/74 Balance	1979/80 Balances under different demand estimates 2/				
	EG 1/	HD	EGM	Mean	RE	LD
Afghanistan	-30	41	51	63	41	83
Bangladesh	7	136	161	190	136	245
India	-785	-128	214	43	204	214
Indonesia	-259	47	182	243	376	438
Iran	-34	197	197	294	363	391
Malaysia	-67	-117	-99	-98	-107	-79
Pakistan	-42	111	147	222	209	333
Philippines	-8	-245	-236	-154	-73	-64
Republic of Korea	36	-20	69	34	246	88
Sri Lanka	-51	3	3	30	51	56
Thailand	-62	[illegible]	-100	-82	-95	-65
ASEAN	-476	-415	-253	-92	100	229
Non-ASEAN	-899	340	842	876	1,250	1,410
11 Countries	-1,375	-75	589	785	1,351	1,640

Sources: 1/ Derived from Expert Group production estimates (table 14) less demand estimates (table 11).

2/ Derived from Expert Group 1979/80 production estimates (table 16) less various demand estimates, i.e. EG = Expert Group, RE = least squares exercise, HD and LD = respectively the highest and lowest demand estimate made for each country by all sources, Mean = the mean of HD and LD for each country (table 12).

/Table 22.

Table 22. Supply-demand balances for nitrogen in 11 ESCAP countries expected in 1984/85 and 1989/90 on the basis of 1979/80 output, and new capacity needed for self-sufficiency

(in '000 tons N)

	Supply-demand balances 1/				New capacity needed for self-sufficiency 2/					
	1984/85		1989/90		1980-1984/85		1985-1989/90		Decade	
	EG	Mean	EG	Mean	EG	Mean	EG	Mean	EG	Mean
Afghanistan	20	9	-27	-33	-	-	34	41	34	41
Bangladesh	66	51	-74	-78	-	-	92	57	92	97
India	-2,509	-1,967	-7,309	-5,333	3,136	2,459	6,000	4,207	9,136	6,666
Indonesi	-86	47	-463	-255	107	-	472	319	579	319
[illegible]	174	136	151	79	-	-	-	-	-	-
[illegible]ysia	-17	-170	-262	-246	219	212	108	98	327	310
[illegible]kist[illegible]	-21[illegible]	-187	-544	-573	[illegible]	234	411	482	680	716
Philip[illegible]	-464	-305	-376	-304	580	381	-	-	580	381
Rep. of Korea	-25	54	-136	-66	31	-	139	82	170	82
Sri Lanka	-24	10	-69	-17	30	-	56	21	86	21
Thailand	-163	-150	-260	-224	204	187	121	93	325	280
ASEAN	-889	-579	-1,362	-1,032	1,111	781	701	510	1,812	1,291
Non-ASEAN	-2,513	-1,842	-8,008	-6,022	3,466	2,693	6,732	4,930	10,198	7,623
Total	-3,402	-2,421	-9,370	-7,054	4,577	3,474	7,433	5,440	12,010	8,914

Sources: 1/ Derived from Expert Group's production estimate for 1979/80 (table 15), less Expert Group and "mean" demand estimates for 1984/85 and 1989/90 (table 12).

2/ Needed new capacity is derived from deficit balances on the basis of 80 per cent utilization in all cases; it does not allow for replacement of lost output due to the phasing out of old plants during the decade; the 1989/90 needed capacity is that remaining after that needed by 1984/85 is put in place.

/Table 23.

Table 23. Supply-demand balances for phosphates in 11 ESCAP countries estimated in 1973/74 and expected in 1979/80, 1984/85 and 1989/90 on the basis of 1979/80 output, and new capacity needed for self-sufficiency (in '000 tons P_2O_5)

	Supply-demand balances				New capacity needed for self-sufficiency 3/		
	1973/74 1/	1979/80 2/	1984/85 2/	1989/90 2/	1980-84/85	1985-89/90	Decade
Afghanistan	-7	-23	-37	-59	46	26	72
Bangladesh	-44	-42	-86	-155	107	87	194
India	-325	-252	-1,193	-2,853	1,491	2,075	3,566
Indonesia	-85	-192	-338	-544	422	258	680
Iran	-40	-81	-97	-113	121	20	141
Malaysia	-37	-96	-135	-190	169	68	237
Pakistan	-54	-106	-207	-299	259	115	374
Philippines	-3	-13	-86	-107	107	27	134
Rep. of Korea	-37	-108	-188	-291	235	129	364
Sri Lanka	-12	-11	-23	-55	29	40	69
Thailand	-45	-104	-161	-250	201	111	312
ASEAN	-170	-405	-720	-1,091	899	464	1,363
Non-ASEAN	-519	-623	-1,831	-3,824	2,288	2,493	4,781
Total	-689	-1,028	-2,551	-4,915	3,187	2,957	6,144

Sources: 1/ 1973/74 supply-demand balances are derived from FAO production statistics estimates (table 14) less xpert Group demand estimates (table 13).

2/ Derived from Expert Group 1979/80 production estimates (table 16) less demand estimates (table 13).

3/ See note 2/ to table 22.

/Table 24.

Table 24. ASEAN supply-demand balances for nitrogen assuming various consumption levels and high and low rates of installation and utilization of production facilities, 1980 and 1985

('000 tons N)

Balances with:	Low consumption 1980	Low consumption 1985	Medium consumption 1980	Medium consumption 1985	High consumption 1980	High consumption 1985
	(a)		(b)		(c)	
High installation and utilization:						
Indonesia	1,240	1,795	1,060	1,525	885	1,260
Malaysia	-60	150	-80	120	-100	90
Philippines	-100	50	-185	-90	-270	-230
Singapore	-	200	-	200	-	200
Thailand	-65	150	-75	135	-90	120
ASEAN	1,015	2,345	720	1,890	425	1,440
Low installation and utilization:	(d)		(e)		(f)	
Indonesia	370	655	190	385	15	120
Malaysia	-75	-135	-95	-165	-115	-195
Philippines	-120	-240	-205	-380	-290	-520
Singapore	-	-	-	-	-	-
Thailand	-80	-135	-90	-150	-105	-165
ASEAN	95	145	-200	-310	-495	-760

Notes: (1) **Production:** The plant development programmes yielding the high and low production projections underlying the above balances are described in paragraphs 162 and 163 of the text (chapter 7).

(2) **Consumption:** Table 12, with extrapolations and rounding.

/Table 25.

Table 25. ASEAN supply-demand balances for nitrogen assuming medium consumption projections and with variable installation and utilization rates adopted for self-sufficiency, 1980 and 1985

('000 tons N)

		Indonesia	Malaysia	Philippines	Thailand	ASEAN
Medium consumption assumptions	1980	590	140	285	100	1,115
	1985	935	210	460	160	1,765
(a) Subregional self-sufficiency (one example)						
1980 Production		910	55	130	20	1,115
S-D Balance		320	-85	-155	-80	-
1985 Production		1,320	295	130	20	1,765
S-D Balance		385	85	-330	-140	..
(b) National self-sufficiency where possible without surpluses						
1980 Production		635	55	300	20	1,010
S-D Balance		45	-85	15	-80	-105
1985 Production		975	230	425	20	1,650
S-D Balance		40	20	-35	-140	-115
(c) National self-sufficiency with surpluses if necessary						
1980 Production		635	295	295	260	1,485
S-D Balance		45	155	10	160	370
1985 Production		1,175	295	600	260	2,330
S-D Balance		240	85	140	100	565

Note: The production figures are calculated variations on the high and low projections used in table 24, with appropriate variations as described in paragraphs 166-169 of the text (chapter 7).

/Table 26.

Table 26. Production, consumption and supply-demand balance estimates for nitrogen in other Asian Countries, 1973/74 and 1979/80

('000 tons N)

	1973/74			1979/80		
	Cn	Pdn	SDB[a]	Cn	Pdn	SDB[a]
Burma	39	48	9	78	48[d]	-30
Cambodia	3	-	-3	4	-	-4
China	3686	2230	-1456	5820	5622	-198
Japan	842	3038	2196	887	3038	2151
Laos	-	-	-	-	-	-
Mongolia	1	-	-1	1	-	-1
Nepal	13	-	-13	32	-	-32
South Vietnam	156	-	-156	276	-	-276
= Other ESCAP	4740	5316	576	7098	8708	1610
11 studied[b]	3648	2274	-1374	7028	7616	588
All ESCAP	8388	7590	-798	14126	16324	2198
Non-ESCAP E. Asia	456	453	-3	643	816	173
Middle East[c]	126	536	410	213	756[d]	543
All Asia	8970	8579	-391	14982	17896	2914

Source: Derived from TVA/IFDC, op. cit., (Appraisal), appendix table A4, pp. 108-111, and from UNIDO/ESCAP Priority Project.

Notes: a/ SDB = Supply-demand balance, i.e. estimated production less estimated consumption.

b/ "11 Studied" are the countries which the UNIDO/ESCAP Priority Project concentrated; Expert Group figures are used here, from tables 11, 12, 13, 14 and 16 above.

c/ "Middle East" excludes Iran, leaving Iraq, Israel, Jordan, Kuwait, Saudi Arabia, Syria and Qatar.

d/ These production figures could be considerably understated.

/Table 27.

Table 27. Production, consumption and supply-demand balance estimates for phosphates in other Asian countries, 1973/74 and 1979/80

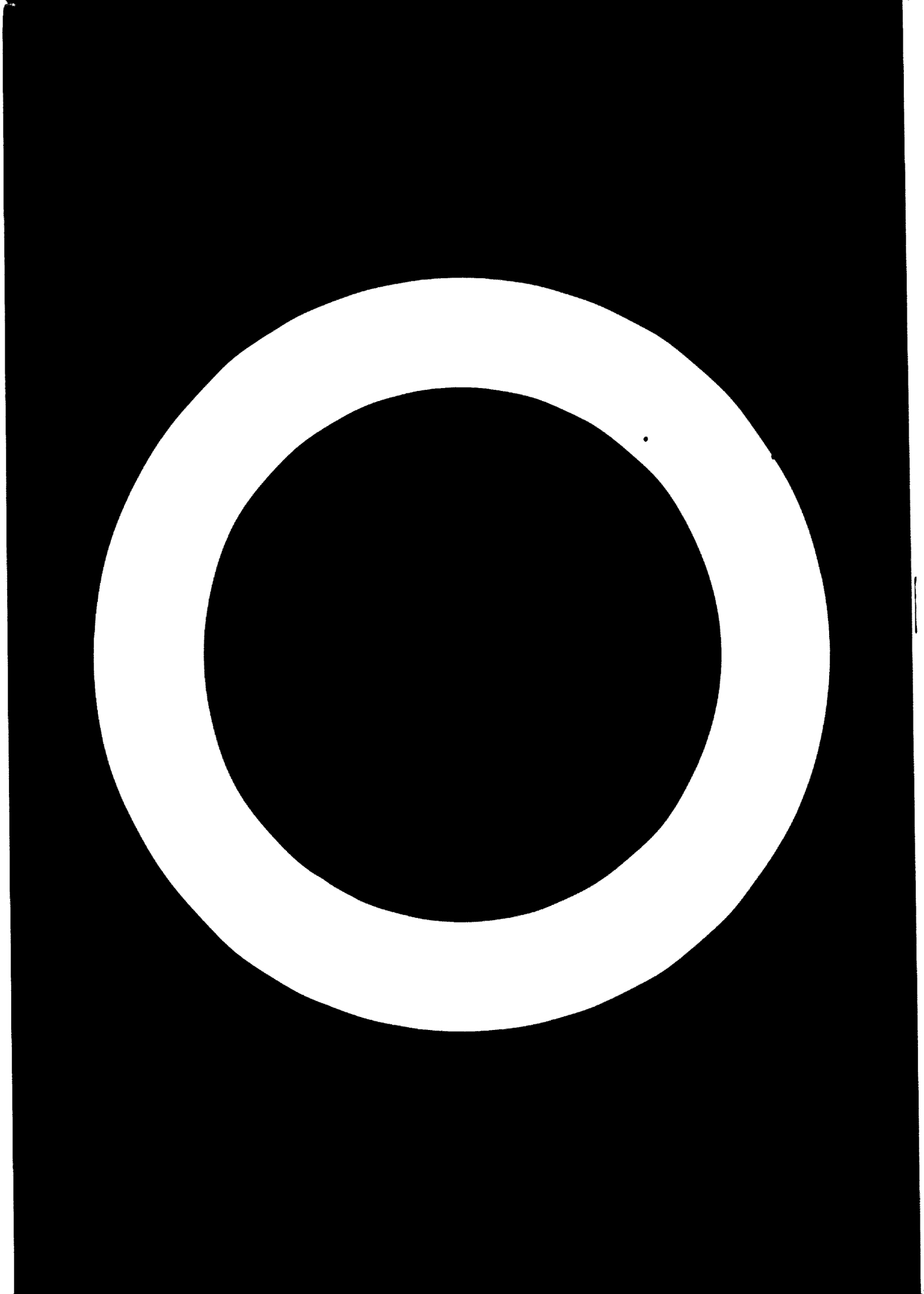
(in '000 tons P_2O_5)

	1973/74			1979/80		
	Cn	Pdn	SDB[a]	Cn	Pdn	SDB[a]
Burma	11	-	-11	21	-	-21
Cambodia	1	-	-1	1	-	-1
China	1005	1019	14	1527	1514	-13
Japan	734	828	94	766	842	76
Laos	-	-	-	-	-	-
Mongolia	2	-	-2	3	-	-3
Nepal	1	-	-1	2	-	-2
South Vietnam	39	-	-39	55	-	-55
= Other ESCAP	1793	1847	54	2375	2356	-19
11 studied[b]	1293	604	-689	2719	1691	-1028
All ESCAP	3086	2451	-635	5094	4047	-1047
Non-ESCAP E. Asia	212	233	21	314	348[d]	34
Middle East[c]	55	247	192	87	526	439
All Asia	3353	2931	-422	5495	4921	-574

Source: See table 26.

Notes: See notes to table 26.

/Annex II



Annex II: Bibliography

Material consulted in the course of the Priority Project includes the publications and unpublished papers listed below. For convenience, those produced by or on behalf of ESCAP,[1] the FAO, UNIDO, TVA/IFDC, the World Bank Group and the APO are grouped in the first six sections, with individual authors in parentheses where appropriate. Papers of other organizations or publishers comprise the final section. This Annex is included for the readers' convenience, although it is not an exhaustive list of all relevant material available on chemical fertilizers.[2]

1. Economic and Social Commission for Asia and the Pacific (ESCAP), including the Mekong Coordinating Committee

1. (Proposal by the Executive Secretary) "Establishment of a World Fertilizer Fund", 1974.
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/Annex III.

Annex III. Report on the Priority Project

The UNIDO/ESCAP Priority Project on Regional Co-operation in Chemical Fertilizer Production and Distribution occurred during 1975, funded by the UN Development Programme as RAS/74/045. This Report covers its authority, objectives, formulation, funding for execution, and executed activities; it also lists documents prepared, project participants, and persons visited on country missions.

Legislative Authority. The Thirtieth Session of the Economic and Social Commission for Asia and the Pacific in March 1974 named food as a priority area for its Secretariat's work programme, expanded the allocation of resources for 1974 and 1975, to Project No. IA2: 7-0.3, Development of regional co-operation schemes for agricultural products and requisites, and specified two activities concerning the latter:

(a) Regional review and analysis on demand and supply of agricultural requisites and assessment of future requirement and availability of these requisites;

(b) Identification of possible methods of regional co-operation on selected agricultural requisites, e.g. fertilizers and pesticides.

Accordingly, the revised ESCAP Programme of Work and Priorities for 1975-77 was subsequently approved with the inclusion of a priority project in regional co-operation in chemical fertilizer production and distribution, renumbered as activity 5(iv) in Programme 01.

Project objectives: The long-term objectives of the present priority project are to provide a common forum for oil-exporting and fertilizer-deficit countries in the region to work out mutually advantageous production-cum-trade arrangements for better utilization of existing installed capacity and for increased fertilizer production and supplies within the developing countries of the region. The immediate objectives are to (i) assist the countries of the region in the fuller utilization of their existing capacity for fertilizer production and distribution, (ii) determine the will of the regional member countries to form co-operative ventures in the production and distribution of chemical fertilizer, and (iii) establish the will of the ESCAP member countries through agreement arrived at in intergovernmental meetings.

/Formulation:

Formulation: In the period between the 30th session of ESCAP and the World Food Conference in November 1974 much of the ESCAP secretariat's work in the field of fertilizers was concerned with implementation of the session's Resolution 142 concerning the establishment of a World Fertilizer Fund which was subsequently incorporated into the International Fund for Agricultural Development. Simultaneously, however, the ESCAP Task Force on Fertilizers[1/] formulated a detailed project to fulfill the Commission's requirement of work on demand, supply and co-operation within the region. This was drafted in July/August 1974, and by November it had been commented on by UNIDO, revised, budgeted at $US 43,240 and submitted by ESCAP to the UNDP for funding as RAS/74/045. Preparatory work which did not require extra-budgetary assistance commenced immediately within the ESCAP secretariat.

Funding for execution: The UNDP gave consideration to appropriate executing arrangements for the priority project, and appointed UNIDO accordingly. On 14 March 1975 the project was approved for execution by UNIDO in co-operation with ESCAP, and a (UNIDO) project manager was appointed to direct activities, initially from Vienna. Consultations between UNIDO and ESCAP had been held in February in New Delhi to further amend the project document on the basis of a revised UNIDO draft, to increase its budget to $US 66,500, and to agree on its schedule of activities.

Executed activities: The project was divided into nine tasks, the first eight of which have been implemented as follows:

1. The identification and recruitment of consultants and the invitation to selected ESCAP member Governments to assist in gathering data were conducted in Bangkok during December 1974 and January 1975. After the project had been formally approved in March further consultants were recruited in Vienna.

2. A Preparatory Paper was drafted by project consultants and the project manager for ESCAP in Bangkok from 20 January to 12 March, and was later complemented by a questionnaire prepared in Vienna.

3. Missions to a selection of developing ESCAP countries were made to collect data and examine the feasibility of regional arrangements for chemical fertilizer production and distribution. Mission "A", to the Republic of Korea, Hong Kong, Brunei, the Philippines, Indonesia, Singapore, Malaysia and Thailand, was conducted from 20 April to 15 May by Mr. G. Kansu, joined for the last

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1/ Now the ESCAP Task Force on Fertilizers and Agricultural Chemicals.

three countries by Mr. R. Vangela. Mission "B" was conducted from 29 April to 2 June in Afghanistan, Pakistan, India, Sri Lanka, Bangladesh and Iran by Messrs S.R. Panfil (project manager) and F.J.E. Van Dierendonck.

4. As delays had occurred in the commencement of the two field missions, the task of joint-discussions in Bangkok between their participants had to be contracted and combined with the following task. However, papers (A1, A2, B1, B2) were prepared on each of the missions and supplementary papers (A3, A4) were added to those covering the Southeast Asian subregion. At this time also, a progress report was made to an ESCAP intergovernmental meeting[2/] convened to discuss the implementation of projects identified by the Asian Industrial Survey for Regional Co-operation. An "action group" on fertilizers and pesticides was formed by several Southeast Asian governments at this meeting.

5. During June, the project team, now consisting of two consultants and the project managers, made preparations for an Expert Group Meeting on the Priority Project. These included the drafting of a summary paper (S) which brought together the material prepared by each mission and subjected it to further analysis. An introductory paper (O) was also prepared to cover the 1973/74 "fertilizer crisis" and international activities in the field.

6. The Expert Group met in Bangkok from 30 June to 5 July to consider the material which had been brought together, tap the experience of the individual experts, and jointly draft a report indicating the scope for regional co-operation, largely in terms of anticipated supply-demand balances.

7. Immediately following the meeting, the Expert Group Report was finalized, processed and made available for the information of interested parties, including ESCAP member Governments at the August meeting of the Committee on Agriculture and the November meeting of the Committee on Industry, Housing and Technology. Both committees called for further work, especially on aspects pertaining to regional co-operation. Meanwhile the work of the project team in early July included also the preparation of a first draft of a UNIDO/ESCAP paper which later was revised to become part of the document to which this Report is annexed. This July draft was a more detailed treatment of the analysis and proposals in the Expert Group Report, and was used as a discussion document for the following project task.

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2/ Meeting of Top Planners and Government Executives, Entrepreneurs and Representatives of Financial Institutions, at Bangkok, Thailand from to 1975.

8. A further country mission "C", this time mainly to developed countries with fertilizer export industries and to international institutions concerned with financial and technical assistance, was conducted in July/August by Messrs M.C. Verghese of UNIDO and R. Hirono of ESCAP. A paper (C) was subsequently prepared in Bangkok to report on the mission and serve as an input to the revision of the UNIDO/ESCAP Paper.

8a. Meanwhile the project manager for ESCAP prepared a further input paper (E) to expand the scope of the project's analysis by taking more account of economic considerations, the scope for subregional arrangements to co-ordinate production plans and trade, and new data available since mid-1975.

9. The final task was to have been an ad hoc intergovernmental Meeting on the scope for regional co-operation in chemical fertilizers among ESCAP member countries. During the course of the project it was decided to postpone such a meeting until specific and detailed proposals would be ready for consideration and implementation, and to submit the more general results of the project to member Governments through other fora in the meantime. Accordingly, proposals were presented in draft form through the Expert Group Report (UNIDO/ESCAP DP/CFPD/2) to the ESCAP Committees on Agriculture (Jakarta, August 1975) and on Industry, Housing and Technology (Bangkok, November 1975). The joint-agency paper Regional Co-operation in Chemical Fertilizers (UNIDO/ESCAP DP/CFPD/3) to which this Report is annexed, was drafted in Bangkok in December, endorsed by both agencies in January, and distributed to member Governments as well as international agencies and research institutions concerned with the subject. Meanwhile the paper's Summary and Recommendations (E/CN.11/L.422/INF) was prepared for the information of the XXXIInd Commission Session (Bangkok, March 1976) and provided to an Intergovernmental Meeting on Agro and Allied Industries (Bangkok, February 1976) and the second meeting of the Consultative Group on Food Production and Investment in Developing Countries (Washington, D.C., February 1976).

Follow-up action: The UNIDO Secretariat has already commenced the formulation of country and regional projects designed to implement several of the 24 Recommendations made in the UNIDO/ESCAP paper. For its part, the ESCAP Secretariat has launched or is participating in projects concerned with domestic distribution and utilization of chemical fertilizers, and has proposed the allocation of several man-months of staff time and the acquisition of extra-budgetary

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finance in 1976/77 to enable further work to be done on production, trade and regional co-operation. It is anticipated that ESCAP member Governments at the XXXIInd Session will endorse the paper's recommendations, indicate priorities among them, and direct the Executive Secretary to initiate or co-operate in appropriate projects to implement them. It would be appropriate for an ad hoc Intergovernment Meeting to be convened later in 1976 to review progress on this implementation and to formalize the establishment of those of the proposed institutions and programmes which may have been made ready for substantive participation by groups of member Governments.

Documents prepared: Apart from procedural reports, the following documents were prepared during the course of the Priority Project:

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S : Summary of Findings, Conclusions and Recommendations on Regional Co-operation among ESCAP Countries in Fertilizer Production and Distribution; S.R. Panfil, H.C. Raghubir, F.J.E. van Dierendonck and C.J.A. Draper, mimeo, June 1975.

/G

G : Report of the Expert Group on Regional Co-operation in Chemical Fertilizer Production and Distribution; mimeo, July 1975.

D : First Draft of UNIDO/ESCAP Paper on the Chemical Fertilizer Situation and Outlook in ESCAP Countries, including Proposals for Regional and Subregional Co-operation; authors as for paper S, mimeo, July 1975.

E : Subregional Economic Co-operation in Chemical Fertilizer; C.J.A. Draper; mimeo, December 1975.

C : Report of Mission "C"; R. Hirono and M.C. Verghese; mimeo, December 1975.

U/E : Regional Co-operation in Chemical Fertilizer; UNIDO/ESCAP DP/CFPD/3; mimeo, January 1976.

R : Summary and Recommendations; E/CN.11/L.422/INF; mimeo, January 1976.

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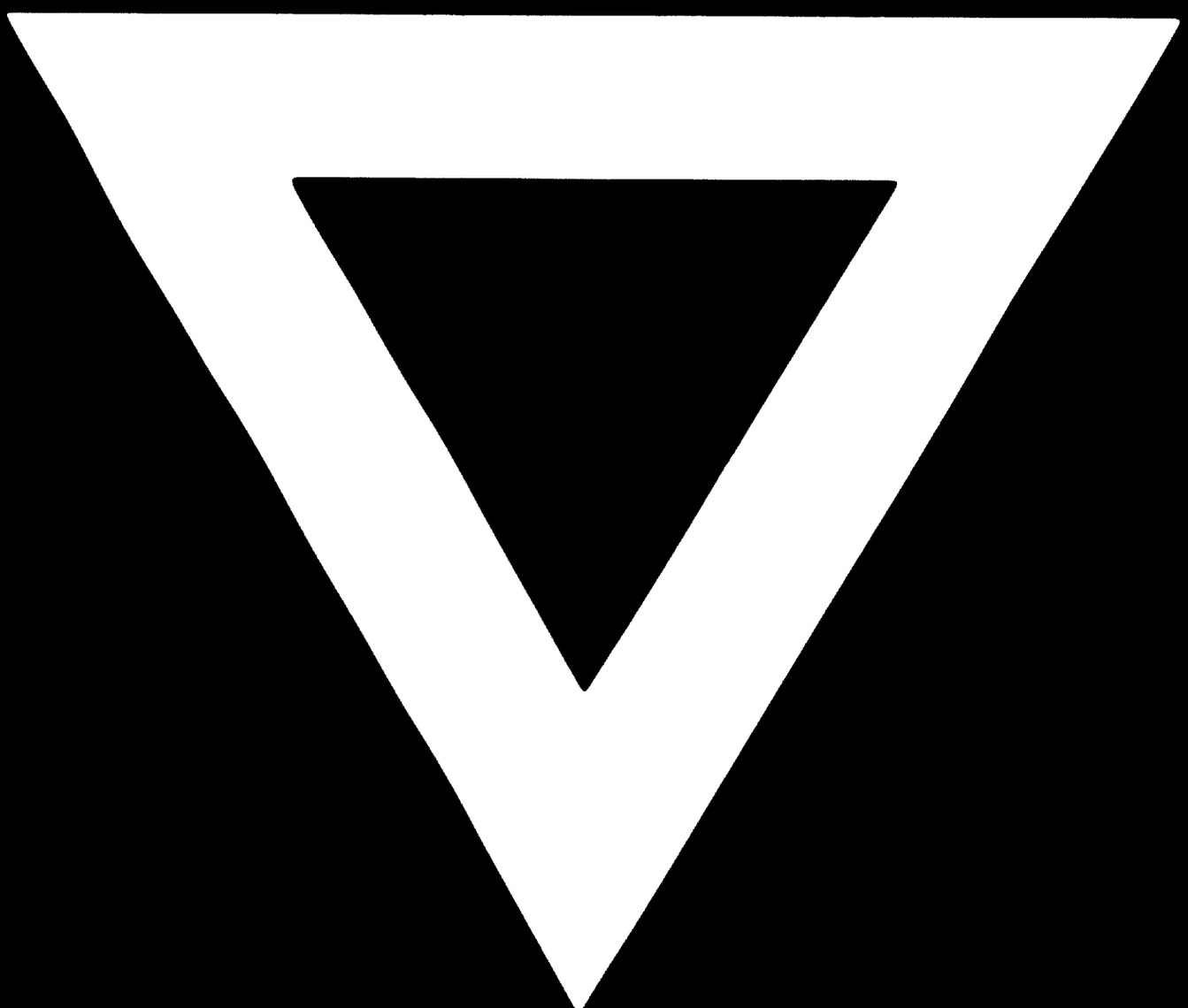

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