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Preparatory Meeting for the
First Consultation Meeting on
the Fertilizer Industry

Vienna, 8 - 12 November 1976

SUPPORTING INFORMATION ON EIGHT ISSUES
WHICH MIGHT BE SELECTED FOR
CONSIDERATION AT THE CONSULTATION MEETING ^{1/}

prepared by the
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* Reissued for technical reasons.

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INTRODUCTION

The Purpose of the Preparatory Meeting

1. The First Consultation Meeting on the Fertilizer Industry will be convened at Vienna, 17-21 January 1977. The over-all objective of the Meeting is to explore ways and means of increasing total world fertilizer production and, in particular, of increasing the share of developing countries in this total. In this connection, the Aide-Memoire announcing the Meeting included as Annex I a tentative list of issues suggested for consideration at the Preparatory Meeting. These are the issues considered in this paper. ^{1/}
2. The participants of the Preparatory Meeting are expected to discuss the eight issues suggested by the UNIDO Secretariat and any other issues that they may wish to consider. The aim will be to advise UNIDO on the selection of a limited number of issues that UNIDO can propose for consideration at the First Consultation Meeting, bearing in mind that other issues may be considered at subsequent Consultation Meetings or in other appropriate fora.
3. This paper provides supporting information on each of the eight issues. ^{2/} Within each issue, some specific points are raised concerning possible ways in which co-operation might be developed between developing and developed countries and amongst developing countries themselves. In considering which issues are most suitable for the Consultation Meeting, participants are invited to consider which of these specific points offer practical and useful suggestions for international co-operation.

^{1/} The word "issue" was translated in French as "questions" and into Spanish as the points suggested "los puntos sugeridos". These translations reflect the co-operative spirit in which points suggested for discussion at the Consultation Meeting might be considered; there is no intention to imply an element of confrontation when using the word "issue" in the English text.

^{2/} The eight issues and specific points within each issue have been identified by the internal Task Force established by the Executive Director of UNIDO to prepare for Consultation on the Fertilizer Industry. In preparing supporting information on each issue, the Task Force has been assisted by consultants.

The opinions of United Nations bodies on the need for international cooperation in developing the Fertilizer Industry

6. The Plan of Action adopted at the World Food Conference in November 1974 declared that

"It is a fundamental responsibility of Governments to work together for higher food production and a more equitable and efficient distribution of food between countries and within countries"....

7. Recognizing the vital role of fertilizer in increasing food production, Resolution III of the Conference

"stressed the need for increased and co-ordinated international efforts to improve fertilizer availability, particularly to developing countries".....

"urged international institutions, the developed countries and others in a position to do so to provide assistance to build the required additional fertilizer production capacity in appropriate developing countries and also to assist all developing countries with storage facilities, distribution services and other related infrastructures".

8. The Declaration and Plan of Action adopted at the Second General Conference of UNIDO at Lima, Peru in March 1975 declared that:

"That, in view of the basic complementarity between industry and agriculture, every attempt should be made to promote agro-based or agro-related industries which besides arresting rural exodus and stimulating food production activities, provide an incentive for the establishment of further natural resource-based industries"...

9. The Lima Conference further recommended that in the developing countries, national industrialization policies should lay emphasis on, inter alia

"The promotion of an integrated industrialization process based on the potential of each country, with the object of achieving the highest degree of interaction between industry and the other sectors of the economy, in particular, agriculture"....

10. For these reasons, the fertilizer industry has been chosen as the first industrial sector in which the urgent consultations that were called for by the Lima Conference should be organized to promote co-operation between developed and developing countries and among the developing countries themselves.

3. The potential growth of world fertilizer industry in the period 1975-2000

9. The fertilizer industry is concerned primarily with the supply of the three basic plant nutrients, nitrogen (N), phosphorous (P) and potassium (K), in the form of a range of chemical products ("fertilizers") containing these elements. The two latter are considered in terms of their oxides, phosphorus pentoxide (P_2O_5) and potassium oxide (K_2O).

10. The basic nutrients may be supplied singly, in fertilizers containing only one nutrient ("straight" fertilizers), or two nutrients or all three nutrients may be supplied in a single fertilizer ("compound" or "complex" fertilizers). In 1975 about 20% of the N and 50% of the P_2O_5 was supplied in compound fertilizers, mainly in the developed countries.

11. Potash fertilizer is obtained as a product of mining operations; it is applied after some beneficiation as a fertilizer or, more usually, is incorporated into compound fertilizers. Potash is thus more a raw material than a manufactured product.

12. It is therefore proposed to concentrate discussion at the First Consultation Meeting on the production of nitrogenous and phosphatic fertilizers and to consider mainly the financial, manpower and other resources needed to produce the larger volume of N and P_2O_5 fertilizer that the world will need in the period 1975-2000. ^{1/}

13. Preliminary estimates show that the broad order of magnitude of increase in the use of all fertilizer nutrients (NPK) which can be expected in the period 1975-2000, compared with that achieved in the past 25 years, is as follows:

	POPULATION			FERTILIZER USE			FERTILIZER USE		
	(billions)			NPK millions tons			Kg per capita		
	1950	1975	2000	1950	1975	2000	1950	1975	2000
Developed countries	0.86	1.13	1.36	13	62	197	15	55	145
Developing countries	1.64	2.84	4.89	1	20	110	0.6	7	23

^{1/} N and P_2O_5 nutrients account for 94 of the 110 million tons NPK used in developing countries and 147 of the 197 million tons NPK use in developed countries forecast for the year 2000.

14. This preliminary estimate suggests that consumption of fertilizers in developed countries by the year 2000 will be 3.2 times the 1975 level; the 1975 level was 4.8 times the 1950 level. Since most people in developed countries are already sufficiently well fed, further studies may well show that an estimate in the range of 150-200 millions tons NPK for the year 2000 is a reasonable one.

15. The per capita consumption of fertilizer in developing countries (including China) is expected to be 3.3 times the 1975 level by the year 2000; in 1975 it was 12 times the very low level used in 1950. However, no one can be sure at this stage just how much fertilizer will need to be used to provide the higher standard of nutrition that most of their population needs. Further studies may well show that an estimate of 100-150 millions tons NPK is a reasonable one.

16. In 1975, the developing countries consumed about 30 per cent of the N and 22 per cent of the P_2O_5 nutrients supplied by the world fertilizer industry; however, they produced only two-thirds of this fertilizer themselves and contributed only 18 per cent of world production of N and P_2O_5 fertilizers.

17. By 1985, the preliminary estimate suggests that the developing countries will consume about 34 per cent of N and about 31 per cent of P_2O_5 nutrients consumed in the world; and by the year 2000 about 39 per cent of both N and P_2O_5 nutrients. Therefore if developing countries are to be self-sufficient, their share of world production of N and P_2O_5 fertilizers will have to reach 33 per cent by 1985 and 40 per cent by the year 2000. ^{1/}

^{1/} Estimates on this and other pages are taken from the preliminary draft of the UNIDO world-wide Study of the Fertilizer Industry which is being prepared by the International Centre for Industrial Studies of UNIDO. A review of this preliminary draft of the Study is being made available to participants as a background document for the Preparatory Meeting.

SUPPORTING INFORMATION ON KEY ISSUES
AFFECTING THE DEVELOPMENT OF THE WORLD-WIDE FERTILIZER INDUSTRY 1975-1980

ISSUE 1.1

THE FUTURE DISTRIBUTION OF WORLD FERTILIZER PRODUCTION
BETWEEN DEVELOPED AND DEVELOPING COUNTRIES

Issue 1(a) Should the Consultation Meeting adopt a goal that the developing countries as a group raise their share of world production of nitrogen and phosphate fertilizers from about 18 per cent in 1975 to between 40 and 50 per cent in the year 2000?

Taking this goal into account:

Issue 1(b) What measures should be adopted by Governments and enterprises in developed countries:

- (i) To encourage the establishment of additional production capacity in developing countries, particularly those endowed with the resources of raw materials and energy needed for nitrogen fertilizer manufacture?
- (ii) To encourage a sustained increase in the volume of fertilizer imported into developed countries from developing countries, inter alia, where appropriate, by discouraging the establishment of additional capacity or replacement of existing capacity in developed countries. ^{1/}

Issue 1(c) What measures should be adopted by Governments of developing countries to encourage the building of new fertilizer plants in their countries?

Issue 1(d) What changes in commercial policies (tariffs, non-tariff barriers, business practices, transport policies) are required to facilitate the changing pattern and increased volume of international trade in finished fertilizers, intermediates and raw materials needed for their production (a) between developing and developed countries and (b) among developing countries themselves?

^{1/} The wording of the Issue 1(b) has been slightly revised as compared to the list of issues distributed with the Aide-Mémoire of 30 September 1976.

Supporting information for Issue 1.1

18. Fertilizer production in developing countries (including China) has been sufficient so far to meet only two-thirds of their domestic requirements which are based on the present low and inadequate levels of fertilizer use. Therefore sufficient production capacity in developed countries has been built to meet both their own needs and the growing import requirements of developing countries. The need for developing countries to rely partly on this source of supply may now gradually be reduced.

19. By 1980, the developing countries could be self-sufficient in the sense that as a group they would export as much nitrogen and phosphatic fertilizer as they import. This would require that the new production capacity planned in developing countries for the period 1975-1980 is completed on time and is utilized at a high rate. In this case, the developing countries would produce 28 per cent of world production in 1980 according to estimates of the FAO/UNIDO/IBRD Working Group made in March 1976.

Developing Countries' Share of World Fertilizer Production
Million tons of N and P₂O₅ nutrients

Year	1950	1955	1960	1965	1970	1975	Est. 1980
Developing countries	0.62	1.03	1.65	3.17	6.39	12.21	27.6
World Total	9.9	14.7	20.3	31.3	49.4	68.0	99.1
Developing countries' share (per cent)	6.2	6.9	8.1	10.1	12.9	18.0	27.8

20. Forecasts of the pattern of demand and supply beyond 1980 and as far ahead as the year 2000 are more tentative. Continued expansion at the rate envisaged for 1975 to 1980 would result in the developing countries producing about 90 million tons of nutrients or about 35% of world production by the year 2000. It is too early yet to be certain that their level of production in 1980 will be as shown above but if it is, it would seem that a 35% or higher share could be attained by the year 2000. If developing countries produced only 35% of world production in 2000, it can be shown that they would then require imports costing about US \$3 billion per year at 1975 prices; and if they produced only 25%, the cost of imports would be approximately US \$10 billion.

21. Therefore it seems reasonable to consider two possible targets for the share of developing countries in world N and P₂O₅ fertilizer production in the year 2000:

Case A: 40 per cent implying production sufficient to meet their own needs.

Case B: 50 per cent providing an additional 20 per cent of production exported to developed countries.

Supporting Information for Issue 1(b)

22. Since 1970, developing countries have begun to export small quantities of both N and P₂O₅ fertilizers to developed countries. By 1980, more developing countries will have substantial new capacity available for export. If an increased volume of fertilizer thus made available for export is to be purchased by developed countries, the plans and policies affecting the establishment of new capacity in these countries may need to be adapted accordingly.

23. An important first step in implementing such international co-operation is the requirement that Governments and enterprises of all countries should be informed of each others plans to establish new fertilizer production capacities. This will induce decision makers in both developed and developing countries to consider the world demand/supply situation before deciding to establish additional capacity or to replace old production capacity with new capacities. In this connexion, both the 5-year forecast of world supply and demand made by the UNIDO/FAO/IBRD Working Group and the 25-year forecast made in the UNIDO Study need to be continued, expanded and regularly up-dated in co-operation with enterprises, Governments and trade organizations.

24. Therefore under Issue 1(b), the Preparatory Meeting should also consider:

- (a) how to make the 5-year forecast and longer-term analysis of the world fertilizer supply and demand situation more authoritative and more useful to decision-makers;
- (b) how Governments of developed countries could ensure that the potential for building fertilizer plants in developing countries is fully considered before additional domestic capacity is established;
- (c) how reduction in the incentives that are sometimes provided to create new capacities and how strict application of environmental criteria could help achieve this goal; and
- (d) whether a forum for regular discussions among decision-makers should be created by the First Consultation Meeting in the form of:
 - (i) further Consultation Meetings in the same forum as the first one;
 - (ii) a Fertilizer Industry Committee of UNIDO, composed of persons similar to the participants of the Preparatory Meeting.

Supporting Information for Issue 1(c)

25. At a national level, Governments of developing countries can encourage the establishment of fertilizer plants by providing the necessary infrastructure, by supporting the development of a nation-wide marketing and distribution system and by providing investment incentives and guarantees.

26. In addition, for many developing countries, the most economic form of production will require the co-operation of a group of countries. The potential for co-operation among developing countries in establishing plants to serve sub-regional markets will be considerable in the period 1980-2000. The geographical break-down of the new plants is expected to be roughly as follows if preliminary estimates of consumption in selected major countries turns out to be a reasonable estimate and capacities are those of the standard-size plants assumed. This estimate is only illustrative as it is based on the assumption that the increase in demand in each country or region is supplied by new plants in that region. This takes no account of plants where location will take advantage of raw materials rather than proximity to markets.

Estimated number of standard-size fertilizer plants to be built 1980 - 2000

	N fertilizer plants	P ₂ O ₅ fertilizer plants
China	67	36
India	41	21
Other Asia	61	31
Asia	169	88
Latin America	31	38
Africa	16	15
Developing Countries (Case A)	216	141
Export production	85	47
Developing Countries (Case B)	301	188

27. The raw materials, sources of energy and even financial resources needed to build such plants are available in developing countries; so too is the experience to operate fertilizer plants. Therefore, with this background in mind, the Preparatory Meeting should consider how regular meetings to consider multi-party co-operation on establishing fertilizer plants at a regional or sub-regional level should be organized and what links such meetings should have to consultations in the global forum.

Supporting Information Issue 1(d)^{2/}

28. Present trade in fertilizer is not significantly affected by tariffs and other obstacles to trade. In most countries, fertilizers are treated as an essential input in agriculture.

29. Although export cartels existed in the past among producers of all three major types of fertilizers: phosphates, potash and nitrogen, experience from the 1960's showed that in a weak market the natural tendency for producers to compete continued to co-exist with cartels. With the development of new sources for fertilizer production in the developing countries themselves, prices may increasingly reflect their national objectives.

^{2/} Paragraphs 28-31 (see page 10) are based on paragraphs 35-43 of a note contributed by the UNCTAD Secretariat. This note will be made available to participants that request it at the Preparatory Meeting.

30. There appears to be no record of restrictions being imposed on the exports from a fertilizer plant built in a developing country as a condition for the transfer of technology.

31. The Preparatory Meeting may decide that Issue 1(d) should be referred to an appropriate forum such as UNCTAD rather than to the UNIDO Consultation Meeting.

ISSUE NO.2

CONSTRUCTION OF FERTILIZER PLANTS IN DEVELOPING COUNTRIES

Taking into account the much larger number of new fertilizer plants that need to be built in both developing and developed countries in the period 1975-2000:

2a) What would be the technology appropriate for developing countries (simpler operations, reduced dependence on external sources for spare parts, standardization)?

2b) What other steps (such as model contracts and assistance with negotiations) should be taken to reduce the investment costs and construction time of new plants built in developing countries?

2c) What magnitude of indigenous technical and administrative personnel and what new forms of technical co-operation will be needed at the plant designing and construction stage in developing countries?

2d) What measures (local manufacture of equipment, local engineering and construction services) should be developed by developing countries, (i) acting individually and (ii) acting collectively, to reduce the foreign exchange costs of new fertilizer plants?

2e) Should the infrastructure required by fertilizer plants built in developing countries be considered as a separate project? Should developed countries or international financing agencies be willing to finance such infrastructure projects on soft terms? ^{1/}

^{1/} Modified slightly from list of issues included in Aide-Memoire

Supporting information for Issue No. 2

32. In the period 1975-80, about over 200 new fertilizer plants are scheduled for construction and start up; about 100 of these plants and about half the additional production capacity thus created (about 10 million tons N and 5 million tons P_2O_5) are planned for location in developing countries. ^{1/}

33. To make estimates for the number of new plants needed in the period 1980-2000, standard-size plants have been assumed: 1000 tpd for ammonia, 1720 tpd for urea and 600 tpd P_2O_5 for phosphatic fertilizer units. The result is as follows:

	Developing countries		Developed countries	
	Case A	Case B	Case A	Case B
N fertilizer plants	216	301	348	261
P_2O_5 fertilizer plants	141	188	182	136

Cases A and B assume developing countries' share of world N and P_2O_5 production reach 40% and 50% respectively, in the year 2000.

34. The capacity to be added in the period 1975-1980 has also been calculated on this basis and used in the following table to show the number of new plants that will need to be built each year on the average in the two periods.

	DEVELOPING COUNTRIES			DEVELOPED COUNTRIES		
	1975-1980	1980-2000	1980-2000	1975-1980	1980-2000	1980-2000
	Estimate	Case A	Case B	Estimate	Case A	Case B
N fertilizer	11	11	15	14	17	13
P_2O_5 fertilizer	9	7	9	7	9	7

Case A and B as defined above.

35. This table shows that during the 1975 to 1980 period developing countries are planning to install a very large addition to their capacity in order to meet their own expanding demand and reduce reliance on imports. The experience gained in implementing these plans will be a good guide for the international co-operation required to construct plants in the 1980's and 1990's.

^{1/} As estimated in March 1976 by FAO/UNIDO/IBRD Working Group.

Supporting information for Issue 2 (a)

36. Bearing in mind that after 1980 about half the new fertilizer plants built in the world are likely to be located in developing countries, the design of these plants in the future may not need to be as sophisticated as the design of plants for operation in developed countries where, for example, total heat recovery is more important. Fertilizer plants for developing countries need to be designed so that they require less trained staff to start up, operate and maintain.

37. In this connexion, more careful consideration should be given to standardisation of design of fertilizer plants, so that economies can be made in engineering, fabrication costs, the time required for construction and in the maintenance of the plants. Standardisation should also facilitate manufacture in the developing countries of much of the plant and equipment needed and reduce their reliance on imported spare parts.^{1/}

38. The Preparatory Meeting should consider how more appropriate and standardised plant designs could be developed in time for their use in developing countries in the 1980s. In which countries might such research and development efforts be undertaken? How and by whom should the required design and engineering expenditure be provided?

39. In the years ahead, it can be anticipated that manufacturing processes known today will be further improved (for example, by the integration of the ammonia and urea production processes); however, such innovations are too risky for developing countries to employ before they are well proven. Therefore, the Preparatory Meeting might consider how the use of such an improved process by the developing countries could be encouraged. For example, could a guarantee be given by the contracting firm, and since Governments already provide insurance against political and commercial risks, would it be feasible to provide cover for such technical risks as well, at least for the first plant.

^{1/} In addition, adequate inventories of spare parts can be kept at a national or regional level at reduced cost.

Supporting information for Issue 2 (b)

40. The first few fertilizer plants built in most developing countries are constructed by a contractor as a turn-key project. In recent years, the number of such "turn-key" plants ordered by developing countries has increased sharply, prices have risen steeply and it has become more difficult for developing countries to acquire adequate and continuing guarantees for the performance of the plant once constructed. Having completed the plant and seen that it operates at the guaranteed performance for several days, most contractors are keen to be free from their obligations.

41. The situation of high demand for fertilizer plants is likely to continue in the 1980's. Some developing countries will therefore need assistance in their negotiations with contractors. Although guidelines exist for the drawing up of a contract for the supply and erection of industrial plants ^{1/}, it may be worthwhile to draw up model contracts for standard types of fertilizer plants.

42. With this situation in mind, the Preparatory Meeting should consider Issue 2(b) and in particular, how such model contracts for fertilizer plants might be drawn up. It should also consider how the Government of the supplier's country could guarantee the performance of the contractor and the major equipment supplied; a guarantee certainly seems desirable for such large contracts, which may now amount to \$200 million for a nitrogenous fertilizer complex. ^{2/}

Supporting information for Issue 2 (c)

43. During the construction of a large fertilizer plant up to 1,500 persons may be employed at the peak phase; of these persons, 200 will be persons skilled in the erection of industrial plants. It is in the interest of the developing country in which the plant is being constructed that as many as possible of these skilled, technical and administrative posts are filled by indigenous personnel.

^{1/} Guidelines for contracting for industrial projects in developing countries UNIDO 1975 UN Sales No. 75.II.B.3 and Counter forms of conditions of Contract for process plants suitable for lump sum contracts in the United Kingdom Institution of Chemical Engineers, London, 1968

^{2/} At present the Government provides a one-sided guarantee against commercial and other risks for the suppliers of equipment and engineering contractor; the purchaser obtains no guarantee.

44. The training of the operation managers and all levels of maintenance personnel can be facilitated if they are recruited at the plant construction stage. Operation managers can be attached to the consultants as trainees, while the maintenance personnel can be trained by the principal contractor. Vendors supplying the equipment will be sending expatriate personnel to erect and commission individual pieces of equipment; the maintenance personnel can gain valuable experience during the process.

45. In this context, the Preparatory Meeting should consider Issue 2(c) and, in particular, whether contracts for the design and erection of fertilizer plants should specify the number and type of indigenous personnel that will be employed and trained by the contractor and whether the Government of the suppliers' country could take on additional obligation for training through voluntary contributions.

Supporting information for Issue 2 (d)

46. Many developing countries will expect to maximise their own indigenous contribution in the form of plant design and engineering, construction services, and locally-manufactured equipment and supplies. The time and cost factors involved will have to be taken into account. There is a strong cost incentive for contractors to make the fullest use of local construction services. In a few advanced developing countries, much of the equipment required can already be manufactured locally.

47. The national measures which can be used to stimulate local fabrication of plant and machinery include:

- (a) Issuing tender notices to local Engineering Industry Associations and arranging for consultations between the Engineering Contractor and local industry representatives.
- (b) Specifying in the contract the total value of the equipment which will have to be procured from indigenous sources.
- (c) Restricting by licensing, imports of equipment to those items that are not manufactured in the country.

48. The Preparatory Meeting may consider measures requiring international co-operation such as:

- (d) Increased co-operation among developing countries based on industrial complementarity and specialization in manufacturing equipment and machinery for fertilizer plants.
- (e) The use of external sources of financing to finance (i) purchase of locally manufactured equipment or (ii) the import of special raw materials needed for local manufacture of selected equipment.

Supporting information for Issue 2 (e)

49. The cost of the infrastructure required for setting up a fertilizer plant in a developing country varies from location to location. For example, many kilometers of railroad, port facilities for handling bulky raw materials, a dam for a reliable water supply may have to be built as well as captive power generating facilities. The costs incurred for such infrastructure are likely to add considerable additional costs to the project at a "grass-root" site where schools, housing, shops, etc. must also be provided. If the fertilizer plant is burdened with additional costs for establishing such infrastructure (which eventually may benefit other users), the farmers may have to pay more for their fertilizer. This may conflict with the high priority given by Government policy to providing cheap fertilizer as a means of stimulating food productions.

50. Bearing these factors in mind, the Preparatory Meeting should consider whether such infrastructure could be financed as a project separate from the manufacturing plant and whether loans or grants from bilateral or multilateral sources of finance should be provided for this purpose on soft terms.

51. In some developing countries, import duties and taxes on imported and/or indigenous machinery, equipment and materials raise the cost of constructing new fertilizer plants. In view of the need to supply low-cost fertilizers to the farmers, the Preparatory Meeting may perhaps note the need to eliminate such taxes.

ISSUE NO. 3

THE OPERATION OF FERTILIZER PLANTS IN
DEVELOPING COUNTRIES AT HIGH RATES OF CAPACITY UTILIZATION

Taking into account the much larger number of new fertilizer plants likely to be built in developing countries in the period 1975-2000, and the estimated requirements of skilled personnel for general management, financial management, plant operations and maintenance in order to achieve a high level of capacity utilization:

Issue 3(a) What form should national training schemes and international co-operation take to ensure an adequate supply of such trained personnel?

Issue 3(b) What forms of co-operation can be developed between developed and developing countries in overcoming bottle-necks, lack of spare parts and other specific problems of plants operating well below their rated capacity?

Supporting Information for Issue 3(a)

52. The average rate of capacity utilization of plants in developing countries based on 330 days per annum of the contractual daily rated capacity, has increased from below 50 per cent to over 60 per cent in the last five years. In the future, it is assumed that new plants constructed in the period 1975-2000 will reach 90 per cent capacity operation within a period of four years.

53. To achieve such high rates of capacity utilization, adequate training must be provided for about 200,000 personnel that will be required to operate the 300 new fertilizer plants built in the period 1980-2000 (Case A). This is a minimum requirement; if additional plants are built to supply export markets (Case B), the personnel requirement may increase to almost 300,000. The break-down for Case A is as follows:

	Nitrogen Fertilizer		Phosphatic Fertilizer	
	1980-1990	1990-2000	1980-1990	1990-2000
Number of plants	82	117	52	95
Managerial	1,000	1,300	1,000	2,000
Technical supervisors	13,000	18,500	5,000	8,500
Operating and maintenance	33,000	46,000	14,000	25,500
Marketing	2,000	3,000	1,000	2,000
Non-technical	9,000	12,200	4,000	7,000
Total personnel	58,000	81,000	25,000	45,000

54. In developing countries where a fertilizer plant is being constructed for the first time, in-plant training for some personnel in similar fertilizer plants operating abroad is usually arranged by the contractor who is building the plant. However, the number of personnel to receive training abroad in advance of the start-up of the plant is often insufficient.

55. A start has been made by UNIDO, by other international organizations and by some developed countries to develop programmes which provide in-plant training in fertilizer enterprises, study tours, and seminars for upgrading of skills. These efforts are not sufficient to meet the demand. Furthermore, they tend to concentrate on higher level skills and do not provide sufficient opportunities for training technical personnel at all the required levels.

56. In this connexion, the Preparatory Meeting may consider the desirable content and duration of training abroad for the personnel that will operate a new fertilizer plant and how many staff should be trained in this way; and how such training abroad might be organized and financed in the period ahead when demand for training places is likely to exceed the opportunities available at present.

57. In developing countries which built their first fertilizer plants in the 1960s, management and operational skills and experience have begun to be transferred from an existing plant to a new plant within the country. In addition, in some developing countries, national training schemes have been set up to train the skilled personnel for new plants.

58. Taking into account the experience outlined above, the Preparatory Meeting should consider Issue 3(a). As regards the development of national training schemes, it is important to consider:

- (a) what contribution enterprises and governments of developed countries could make to the national training schemes of developing countries;
- (b) how co-operation on training among developing countries themselves could be organized and financed; and
- (c) what contribution UNIDO could make through an international fertilizer training programme.

59. Experience in some developing countries suggests that fertilizer projects which took advantage of management contracts or were based on joint ventures with foreign partners have attained relatively high rates of capacity utilization. Where training arranged by the contractor has been the only form of international co-operation used, less satisfactory results have been achieved. In particular, in countries where there was no possibility to use managers and technicians who already had experience of operating chemical plants, it has proved difficult to develop the skills needed to operate the first fertilizer plant to be built in the country.

60. It is therefore necessary to consider alternative arrangements that could be made to employ experienced management teams and technical experts to assist in the start-up and subsequent operation of new fertilizer plants (a management contract with an existing producer, joint-venture arrangements, or other special forms of agreement, etc.) and how Governments of developing and developed countries could initiate and support such co-operation.

Supporting Information for Issue 3(b)

61. The five most widely experienced technical constraints on full capacity utilization are considered here:

- Deficient design and quality of equipment ;
- Plant bottlenecks;
- Lack of spare parts;
- Unreliable power supply;
- Unsuitable sources of cooling water.

Design and quality of equipment

62. In certain fertilizer plants in developing countries, design deficiencies and the low quality and/or short life of some equipment have been the cause of low capacity utilization at a later stage of commercial operation of plants.

63. On this point, the Preparatory Meeting should consider what steps Governments should take to ensure that reliable and responsible engineering contractors and suppliers of equipment are selected. In this connection, consideration of the guarantees that Governments may give for the performance of contractors and equipment suppliers (Issue 2 (b)) and for new manufacturing processes (Issue 2 (a)) is relevant.

Plant bottlenecks

64. A plant bottleneck is a technical constraint limiting the plant's output; de-bottlenecking of plants often implies redesign of certain sections of the process plant and/or equipment.

65. In the simple case, it may be found that low capacity utilisation is caused by poor maintenance procedures, inadequate recording of machine performance, etc., which may be remedied by:

- improvement of maintenance procedures;
- upgrading of skills of the maintenance staff;
- application of a preventive maintenance system; and
- replacement of equipment.

66. In more complex cases, the cause may be the low performance of certain machines or certain sections of the process plant. Since these suggest design deficiencies, the equipment supplier and/or the contractor who built the plant and/or the licensor of the process will need to be approached.

67. On this point, the Preparatory Meeting should consider:

- (a) whether the contractors and suppliers who built the initial project should be obliged to provide technical and financial assistance when debottlenecking or modernizing of this plant becomes necessary within a reasonable time after commissioning? If so, what form this obligation should take and how Governments could reinforce it?
- (b) how and by whom an exchange of experience should be organised (i) among technical staff operating and maintaining similar fertilizer plants in various different countries and (ii) between these staff and the contractors who built the plants they operate?

Spare parts

68. In certain fertilizer plants in developing countries, lack of timely supply of spare parts or inadequate inventories has impeded maintenance work and contributed to low rates of capacity utilization. The causes of inadequate supplies of spare parts can be attributed to lack of stand-by equipment for essential items such as centrifugal compressors, special valves and pumps, etc. and/or difficulties or delays in obtaining foreign currency to purchase spare parts from abroad.

69. On this point, the Preparatory Meeting should consider:

- (a) whether by constructing a number of "standard" plants equipped with identical machines, a sub-regional pool of certain spare parts and other items such as catalysts can be established;
- (b) the supporting of National Emergency Funds established to finance imports of urgently needed spare parts through "programme loans", etc.;
- (c) establishing an international co-operation programme among fertilizer manufacturers of the developed and developing countries for mutual assistance in (i) the acquiring of spare parts (ii) recommending the standardization of certain items of equipment.

Unreliable power supply

70. Many fertilizer plants operating in developing countries have suffered from an unreliable supply of power. In one country, an estimated 6 per cent of the year's potential fertilizer output was lost in 1974 owing to constraints imposed by the unreliability of power supplied by the national grid. Although high investment costs are involved in setting up a power generator at the plant site, such captive power supplies may be indispensable for achieving high rates of capacity utilization.

71. On this point, the Preparatory Meeting may note that new fertilizer plants should be allowed (and perhaps in some countries required) to include captive power supplies. This is mainly a national problem; however such projects might be financed as essential infrastructure on soft terms.

Cooling water

72. Cooling water availability and its quality is another important factor because low capacity utilization is frequently caused by scaling and corrosion of heat exchangers in fertilizer plants.

73. On this point, the Preparatory Meeting might note the need to give priority attention to water supplies and the use of water conservation equipment in many plant locations and to soft-term financing for such projects.

ISSUE NO. 4

THE FINANCING REQUIRED TO BUILD FERTILIZER PLANTS IN
DEVELOPING COUNTRIES

Taking into account the large volume of financing that will be required for the construction of new fertilizer plants in developing countries - at least \$2,000 million per annum (at 1975 prices) in the period 1980-2000:

Suggestion 4(a) What measures can developing countries take to maximize financing from internal resources of existing enterprises and other national sources?

Suggestion 4(b) If an external contribution to financing is required, what forms should it take (export credits, equity, investment, loan capital, or new forms of financing such as leasing)? Are preferred terms justified for the financing of new fertilizer plants as compared with the terms prevailing for other industries?

Suggestion 4(c) Is a new institutional mechanism (such as the proposed World Fertilizer Development Fund or the proposed Industrial Development Fund of UNIDO) needed to ensure that a sufficient volume of financing is provided on adequate terms?

General supporting information

74. To estimate the financing required, it has been assumed that the cost of constructing standard-size plants would be: \$103 million for a 1000 tpd ammonia plant based on natural gas; \$67 million for a 1720 tpd urea plant; and \$125 million for a 600 tpd P₂O₅ phosphate fertilizer complex. Based on these estimates, which do not allow for inflation of prices after 1975, the financing required to build fertilizer plants in developing countries in the period 1980-2000 is as shown in the table on the next page.

Financing required to build fertilizer plants in developing countries 1980 - 2000

US \$ Billions

	N Fertilizer Plants		P ₂ O ₅ Fertilizer Plants		Total	
	1980-1990	1990-2000	1980-1990	1990-2000	1980-1990	1990-2000
Case A ^{1/}	14.8	21.1	6.5	11.5	21.3	32.6
Case B ^{1/}	19.5	32.9	10.5	14.1	30.0	47.0

75. The volume of financing required each year to build fertilizer plants in the developing countries in the 1980s will be between \$2 billion (Case A) and \$3 billion (Case B); in the 1990s the financing needed will rise to between \$3 billion (Case A) and \$4 billion (Case B). These estimates make no allowance for the impact of inflation on the cost of standard-size plants; unit costs prevailing in 1975 have been used.

76. About half the nitrogenous fertilizer plants and about one-third of the phosphatic fertilizer plants needed in the period 1980-2000 to supply domestic markets (Case A) are likely to be built in China and India; the volume of financing required for these plants is so large that it should probably be considered separately.

77. It has been estimated tentatively that, on the basis of experience during the 1975-80 period, the cost of new fertilizer plants can be broken down between foreign exchange costs (about 60 per cent), and domestic expenses (about 40 per cent). Thus for the period 1980-1990, the foreign exchange required will be about \$1.3 billion per annum; this is only a few per cent of the total foreign exchange requirements of the industrial sector; it can be compared with World Bank/IDA commitments for financing industrial projects totalling \$3 billion in the year to 30 June 1976, of which \$1 billion was for fertilizer and chemical industry projects.

78. Today most investment institutions require that the ratio of equity to loan capital for such capital-intensive projects should be 1:1 or under certain conditions 1:2. These two requirements have to be satisfied in arranging the financing of new fertilizer plants established in the private or mixed sectors of the economy.

^{1/} Case A and B assume that the developing countries' share of world N and P₂O₅ fertilizer production will reach 40 and 50 per cent, respectively, in the year 2000 (see para. 21).

Supporting information for Issue 4(a)

79. Each new fertilizer complex may cost at least \$125 million (P₂O₅ fertilizer complex) and \$200 million (N fertilizer complex). It may prove difficult for a developing country to raise domestic financing equal to 40 per cent of this total cost. The case studies of ten plants recently built in developing countries that have been examined by UNIDO show that the Government or a Government institution has supplied at least a major part of the domestic financing and equity capital. This practice will almost certainly need to be continued in the 1980s and 1990s in most developing countries, except in cases where the Government accepts that foreign capital may contribute a large share of the equity capital and foreign capital is willing to do so.

80. In developing countries where the fertilizer industry is already established, a contribution to the cost of establishing new plants can be expected from the retained earnings of existing fertilizer enterprises. However, fertilizer prices may be controlled at a level which does not allow existing enterprises to accumulate sufficient funds from retained earnings. Furthermore, since the cost of constructing a standard size fertilizer plant has risen sharply, part of these earnings may be needed to supplement depreciation provisions so as to put them on a replacement cost basis. Therefore, additional equity capital from external sources will usually be required for new large fertilizer projects built in developing countries in the 1980s and 1990s, except in capital-surplus countries.

81. Issue 4(a) is mainly a question of national policy; however, the Preparatory Meeting may care to note the measures that Governments will need to take to maximize the contribution of domestic financing.

Supporting information for Issue 4(b)

82. The examination of ten cases shows that external sources have provided a major part of the cost of financing new fertilizer enterprises built in the 1970s in developing countries. In several cases, a foreign enterprise has taken a sizeable share of the equity capital; in every case, loan capital has been provided from many different external sources

such as the World Bank Group, regional and national development banks, special investment funds of OPEC countries, bilateral aid and export credits of developed countries.

83. At present, most institutions providing finance from external sources insist that their funds be used to purchase machinery and equipment purchased from abroad. This policy will need to be modified so as to permit purchases from domestic sources as well. (See Issue 2(d), para. (c).)

84. As a special case, developing countries may consider assistance from CMEA countries, for example through the International Investment Bank.

85. With this background in mind, the Preparatory Meeting should consider Issue 4(b) and, in addition, the need for a more flexible policy on the use of external sources of financing to purchase machinery and equipment manufactured in the developing country in which the fertilizer plant is built.

Supporting information on Issue 4(c)

86. Given the large volume of financial resources required from both domestic and external sources, there is a need to make a world-wide estimate of the financing required for new fertilizer plants in developing countries and to compare this estimate with the volume of funds likely to be made available from domestic sources and the external sources considered above. If this world-wide estimate shows (as seems likely) that financing may prove an obstacle to the achievements of the higher levels of production needed by developing countries, new forms of international co-operation on financing will be required.

87. In this context, the Preparatory Meeting should consider Issue 4(c) and recommend ways in which a higher priority can be accorded to financing fertilizer projects with the resources available from existing domestic and external sources. If additional external sources are required, the need to take steps to initiate the establishment of an International Fertilizer Industry Development Fund may be considered. Alternatively, the Meeting could recommend that the resources of any new International Industrial Development Fund be such that it may contribute up to \$500 million per annum to the financing of new fertilizer industries.

ISSUE NO. 5

THE STABILITY OF FERTILIZER PRICES

Taking into account the excessive fluctuations in the price of fertilizers in recent years, and measures already taken by Governments and international bodies (such as FAO) to ensure that developing countries obtain an adequate supply of fertilizers:

Issue 5(a) Is there a need for further action to develop a mechanism promising greater stability in the price of fertilizers in a way equitable to consumers and producers?

Issue 5(b) Is the establishment of a buffer stock of fertilizers of sufficient size to overcome price fluctuations technically feasible, and if so, by which parties and under what conditions could it be established and financed?

Issue 5(c) What form could contracts take (escalation clauses) regarding the price at which fertilizer is supplied over a period of years? Should international bodies offer a forum for the negotiation of such contracts?

Issue 5(d) What steps can be taken to support the decision of the OPEC Summit in Algiers in 1975 to produce fertilizers in OPEC countries for sales to developing countries under favourable terms and conditions. ^{1/}

Supporting Information

88. In the past, there have been fluctuations in the availability and price of fertilizers supplied to developing countries. The fluctuation in price of nitrogenous, phosphatic and compound fertilizers over the last 10 years are shown in Chart A. Over long periods the price of imports was usually below the price at which exporters sold fertilizers in their domestic market.

^{1/} The last issue was Issue 5(b) in the Aide-Mémoire.

89. Export prices have generally only risen above the level of domestic prices when there was a temporary and apparent shortage of supplies; Chart B compares the domestic and export price of nitrogenous fertilizers in the fertilizer years 1971-1975. In 1974-75, export prices increased to between 3 and 4 times their previous level as a consequence of many factors including sharply increased prices for energy, raw materials and equipment; but, as Charts A and B show, they began to decline in 1975 and reached more normal levels again in 1976.

90. The high prices prevailing in 1974-1975 made it difficult for many developing countries to pay for a sufficient volume of imports of fertilizers. More serious, farmers responded to the very high prices by using less fertilizer or by growing different varieties of crops that needed less fertilizer. The drop in fertilizer use was greatest in countries where food prices were controlled at what became unremunerative levels. Clearly both these adverse effects on food production need to be avoided in the future.

91. Partly as a reaction to the high prices and temporary shortages prevailing in 1974-1975, developing countries have planned to increase their production capacity for fertilizers in the period 1975-1980 by about the same amount as the developed countries (10 million metric tons N and 5 million metric tons P₂O₅, respectively). If all the 100 or more new nitrogenous and phosphatic fertilizer plants planned for construction in this period are completed on time and operate at high rates of capacity utilization, the developing countries as a group may need to rely less on imports from developed countries by the year 1980 than they did in 1974.

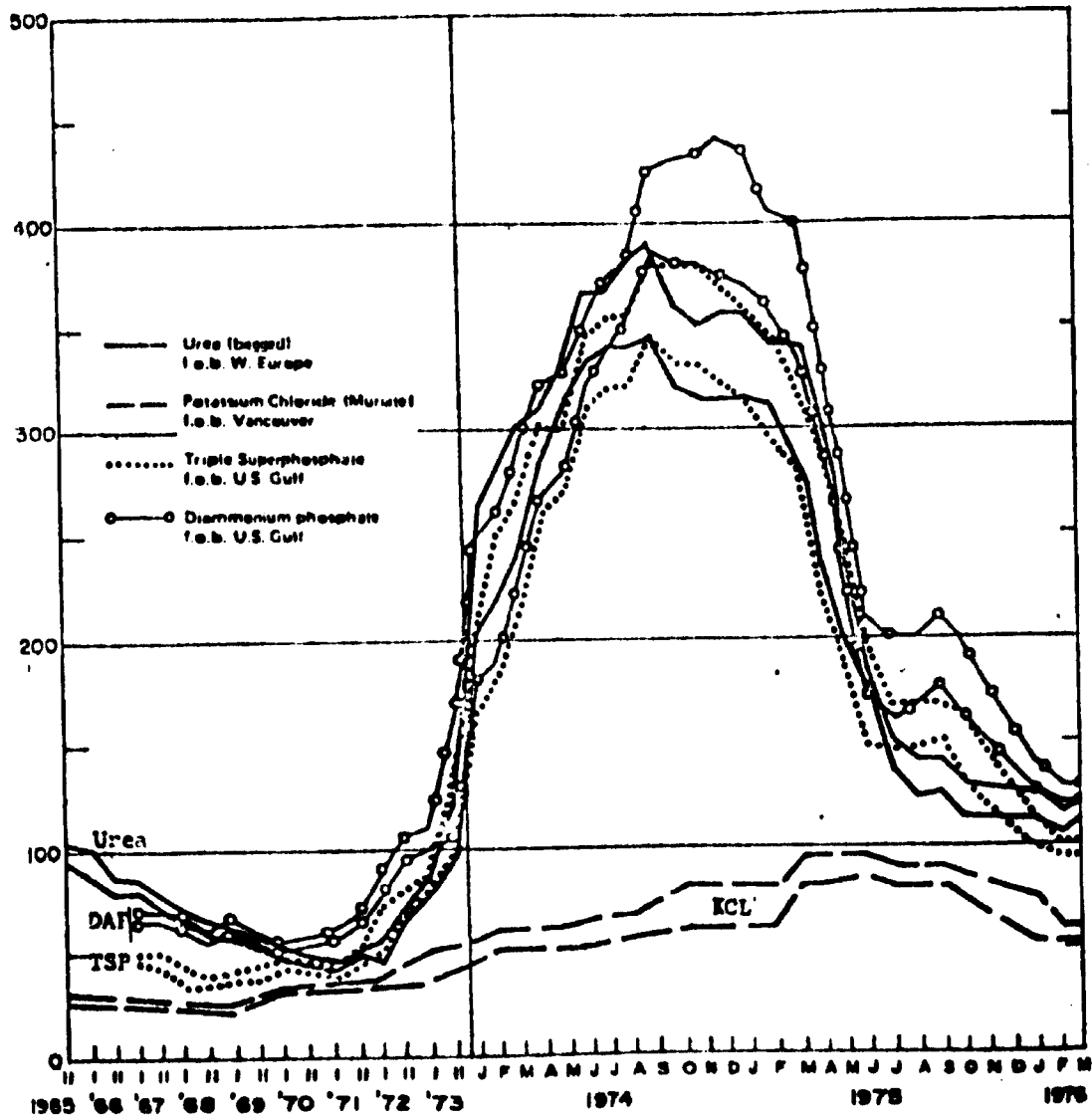
Supporting Information for Issue 5(a)

92. However, the world-wide balance of supply and demand can only be estimated. Although there is currently a surplus of fertilizer production available, past experience shows that apparent shortages of supply can develop suddenly and that when they do, speculative buying tends to exaggerate the fluctuations in both the availability and price of fertilizers supplied to developing countries.

93. The international community has so far failed to develop a scheme of co-operation to reduce such price fluctuations. The only measure initiated successfully so far is the International Fertilizer Supply Scheme which handled about 20 per cent of the fertilizers supplied to developing countries as development assistance in 1975/76; the other 80 per cent was supplied under

Chart A

Export Prices for Some Major Fertilizer Materials
(U.S. \$ per metric ton of product)



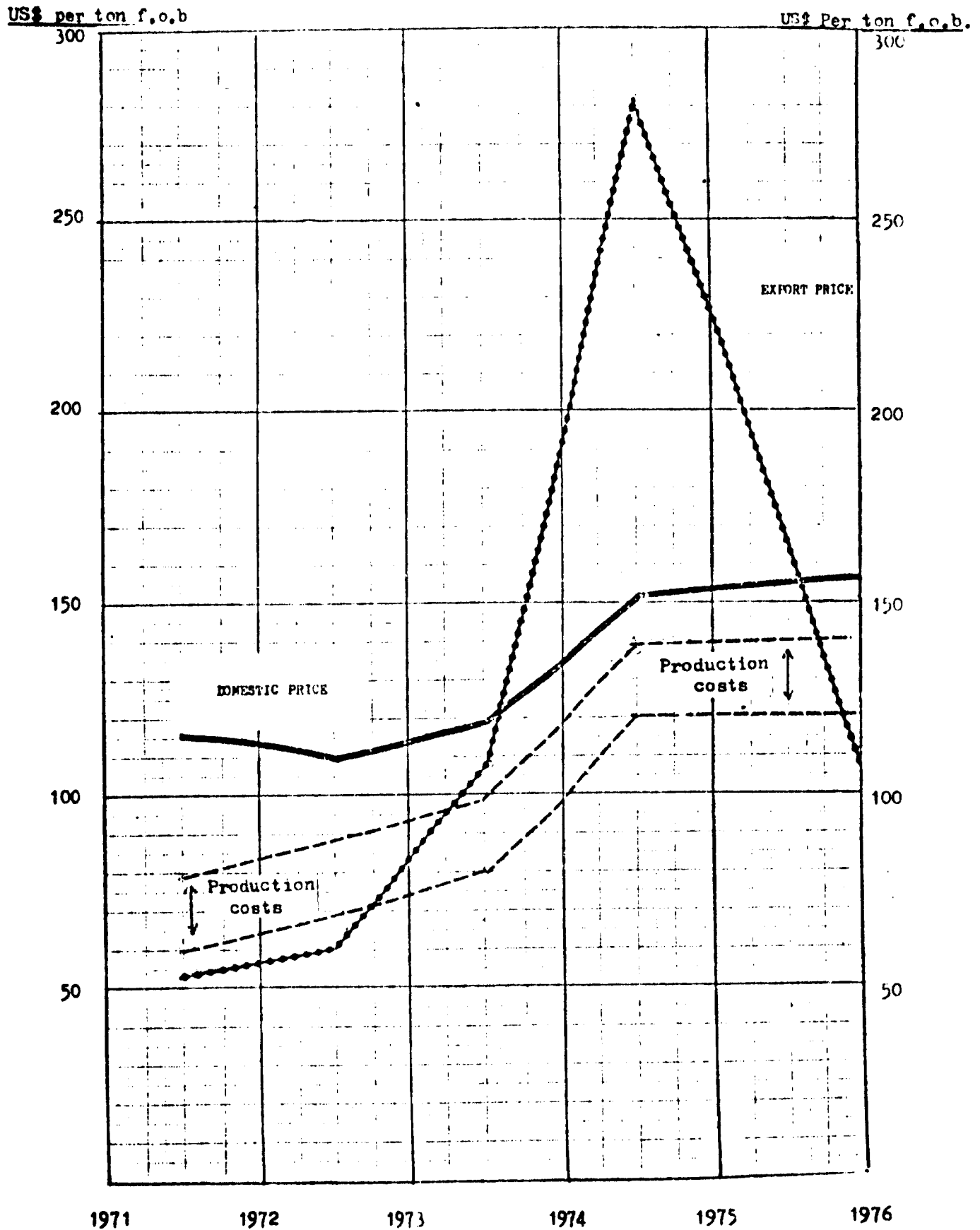
The double lines indicate the price ranges for each product.

Source: World Bank, 1965 to October 1975. November 1975 to March 1976 based on information obtained from various sources.

This chart was presented to FAO Commission on Fertilizers, Third Session, Rome, 8-11 June 1976 in AGS: F/76/2 Current Fertilizer Situation and Longer-term Outlook.

Chart B

COMPARISON OF DOMESTIC SELLING PRICE AND AVERAGE EXPORT PRICE
OF UREA FOR FERTILIZER YEARS 1971-76 OF ONE DEVELOPED COUNTRY



bilateral arrangements. However, since the total volume of fertilizer thus supplied amounted to no more than 12-13 per cent of developing countries' total import requirements in 1975/76, the scheme has been of significant assistance so far only for developing countries with small import requirements.

94. Besides initiating this scheme, the Commission on Fertilizers of FAO has considered the possibility of introducing an international commodity agreement, buffer stocks and long-term contracts as price stabilization measures. The Commission has not been able to agree so far that any of these three possible solutions were practical enough in the case of fertilizers to be implemented.^{2/}

95. Therefore, it appears that there is need to develop a new mechanism promising greater stability in the price of fertilizers.

Supporting Information for Issue 5(b)

96. With regards to the possible use of buffer stocks, the Working Group of FAO on price stabilization measures felt that to control fertilizer prices effectively, "the stocks involved and consequently the costs would be large". This opinion appears to have been based, inter alia, on the inclusion of the high costs involved to build additional storage facilities for the buffer stock that would have to be carried by the scheme itself.

97. One way to avoid the need for an international buffer stock to absorb the high costs involved in building its own storage facilities would be for national governments to require as strategic measures that all fertilizer plants in developed countries build storage facilities to hold larger stocks than they do at present and guarantee that part of this stock would be made available when needed to developing countries. Who would pay for the cost of such additional storage and stocks is the main problem here.

98. Another approach, would be for an international body to buy an appropriate quantity of fertilizers from various producers all over the world with the added condition that these quantities were stored or otherwise made available by the manufacturer. The fertilizer thus purchased by the international body would be considered as property of the international body. In order to use the fertilizer thus committed, the international body would be required to give to the producer notice three to six months in advance of shipment. This

^{2/} See paras. 42-48 of the Report of the Third Session of the Commission on Fertilizers, FAO, Rome, 3-11 June 1976.

proposal might be acceptable to the industry; there are relatively few spot sales as fertilizer must be packed to the buyer's specification and transport must be arranged.

99. Therefore, under this point, the Preparatory Meeting might consider the feasibility of one or the other of these schemes for making supply commitments to an international body. If one is found feasible, the Meeting should recommend in which form the new proposals may be further considered.

Supporting Information for Issue 7(c)

100. The FAO Commission on Fertilizers has considered long-term contracts, as a price stabilization measure, and has requested that FAO continue its study of long-term contracts, particularly with regard to enforcement procedures. Any system of long-term contracts, if found, would have to include effective arrangements for a suitable base price plus a price adjustment formula fair and equitable to both producers and consumers.

101. The main difficulty in drawing up such long-term contracts is that there exists no uniform market price for the many different types of nitrogenous, phosphatic and compound fertilizers traded internationally; in addition, in export markets fertilizer is sold in most cases at a delivered price which varies from area to area and depends above all on considerable fluctuations in shipping rates. It is also difficult to suggest a way of adjusting prices over a period of years that is both equitable to consumers and producers and enforceable by the party hurt by failure to comply to the contract.

102. Therefore, it is suggested that the Preparatory Meeting devote special attention to examining the possibility of implementing an alternative proposal for long-term purchase options for developing countries that provides an insurance for developing countries against excessive high cost of fertilizer imports without all the difficulties of a long-term supply contract.

103. An option is a purchasing right granted by a seller to a buyer to call for a delivery within a specified period under specified price conditions. An option is a one-sided obligation of the seller. It is suggested that producers/exporters in both developed and developing countries participating in the scheme grant an option to an international body to allocate on their behalf to developing countries a certain quantity of fertilizer every year for 5 years.

104. It is not realistic to ask producers for an option for five years at a firm price for this period. No producer can comply with this request as costs of production, of feed-stock, fuel and other raw materials will be fluctuating. Therefore, it is suggested that the option price ex-factory be the prevailing price at which the producer sells ex-factory in his own domestic market. ^{3/} Of course, additional costs for export packing and transportation to the developing country would have to be added.

105. Pricing arrangements other than the domestic price have been considered but this one seems the most practical. It has the advantage that prices for deliveries to the domestic market are controlled by the Government in most countries; prices are therefore reasonably related to the actual cost of production.

106. To administer the scheme, a small administrative office could be established. The Office of the Administrator could be located in the Headquarters of UNIDO or FAO. Two experts with extensive experience of the international fertilizer trade and one secretary should be able to carry the following essential tasks:

- (a) collect options to sell fertilizers from producers/exporters participating in the scheme;
- (b) collect requests from developing countries to make purchases under the scheme;
- (c) allocate sales options to match these requested purchases;
- (d) advise exporters and buyers of these allocations so that they can exchange contracts;
- (e) report on implementation of allocations, contracts, delivery and prices.

^{3/} For producers/exporters which have only a small home market, the price might be determined by the average domestic market price of all other participating producers.

107. The advantages of the above scheme for developing countries would be that they will be sure to have every year for five years the opportunity to buy fertilizers at the domestic market price of producers/exporters. They will only make use of this opportunity in a shortage situation when export prices are expected to be higher than domestic prices. Since no cost is involved, there are no disadvantages for developing countries.

108. For producers/exporters the advantage of the scheme is that sales which are contracted under the scheme are assured 6-9 months in advance of shipment and he can plan his production accordingly.

109. The Preparatory Meeting is invited to consider the above proposal thoroughly so that if deemed appropriate, the Consultation Meeting may authorize the immediate establishment of the scheme. ^{4/} In this case, the first set of sales options by producers and the requirements of developing countries could be collected in the period up to 30 June 1977. This would mean that developing countries would have the right to take up these options for the first time in the Fertilizer Year starting 1 July 1978.

Supporting Information for Issue 5(d)

110. At their First Conference in Algiers in March 1975, the Sovereigns and Heads of State of OPEC Member Countries adopted the Solemn Declaration which, inter alia, stated that the Sovereigns and Heads of State have decided to promote the production of fertilizers with the aim of supplying such production under favourable terms and conditions to the countries most affected by the economic crisis.

111. Additional fertilizer capacity will take 4-6 years to build. But when it is built it will add to the various sources of supply available to developing countries; favourable terms and conditions can also help the developing countries concerned to purchase fertilizers in sufficient quantities for their agricultural needs.

112. In this context, the Preparatory Meeting should consider the potential role which production in OPEC countries can make to meeting the world-wide demand for fertilizers in the 1980s and the possibility for granting favourable prices.

^{4/} Further details of the above scheme will be provided at the Preparatory Meeting.

ISSUE No. 5

ALTERNATIVE APPROACHES OPEN TO
COUNTRIES WITH SMALL FERTILIZER MARKETS

For a developing countries with a small market it may be appropriate:

- (a) to construct a plant to serve the regional market of a group of developing countries;
- (b) To construct a satellite plant to manufacture finished products from imported intermediate products (ammonia, phosphoric acid, etc.);
- (c) To construct a plant to store finished fertilizer products imported in bulk and to dry-blend them as the local market requires.

What forms should co-operation take between developed and developing countries and among developing countries themselves (a) to help such countries examine these options thoroughly and (b) to implement the option selected.^{1/}

Supporting information for Issue 5

Manufacture of fertilizers based on sub-regional co-operation

113. By combining the markets of several small countries, a sub-regional group may be able to make use of the economies of large-scale production by constructing initially only one plant to serve the market of all the countries. Such co-operation may extend to the production of intermediates as well if they can be transported economically. Provided good transport facilities are available within the sub-region, this solution may be the one that promises locally manufactured fertilizers at the lowest costs.

^{1/} This issue has been modified compared to the issue in the Aide-Memoire so that possible forms of international co-operation are considered.

114. In the fertilizer industry, there are some cases in which such sub-regional co-operation among developing countries has been investigated and in one case (ASEAN) agreed among the participating countries.

115. On this alternative, the Preparatory Meeting might consider how regional co-operation can help in making the preparatory investigation that is required to ensure that this option is carefully considered by all potential participating countries. The question of in what forum implementation of the proposal can be negotiated was raised in Issue 1 (c) above.

Manufacture of fertilizers based on imported intermediates

116. A developing country with a medium-size market may consider manufacturing fertilizers from imported intermediates such as ammonia, phosphoric acid and mono-ammonium phosphate (MAP). Such processing plants require lower capital investment than an integrated complex. They may comprise a reaction section, a granulator, a drier, cooler and coater. The capital cost of a plant for the production of complex fertilizers is likely to be from \$10 million upwards, depending on the production capacity needed.^{1/}

117. When a developing country has a market of between 100,000 and 250,000 tons/year of fertilizer, it could consider the setting up of a plant for the production of a complex fertilizer, using ammonia, phosphoric acid, urea and muriate of potash imported in bulk. Such a plant will necessarily have to be located near a port, as ammonia and phosphoric acid will be received in special sea going tankers.

^{1/} Where the required feedstocks can be manufactured locally using local raw materials consideration may also be given to small ammonia/urea or nitro-phosphate plants that are designed to serve only that part of the sub-regional market that lies within a 150 mile radius. For example, the cost of a plant for the production of 100 tons/day of superphosphate is estimated to be of the order of \$5 million. Only markets within 150 miles can be considered as single superphosphate has a low P_2O_5 nutrient content. In addition to phosphate rock, a local source of sulphuric acid will be needed.

118. Such ventures are most attractive when imported intermediates such as ammonia and sulphuric acid are available from a reliable source at competitive prices. An Israeli supplier and user can establish an interdependence agreement, for example under a long-term supply contract, the presence of which is called a "satellite plant" of the producer of the feedstock concerned.

119. To realize this alternative, the Preparatory Meeting might consider whether the "satellite" meeting in another form is suitable for exchanging information among potential suppliers and potential users of intermediate such as ammonia, phosphoric acid and MAP, and how Governments can ensure the implementation of agreement that may subsequently be negotiated.

Dry-blend fertilizer imported in bulk

120. A country with a very small basket for fertilizers may consider importing straight fertilizers such as urea, muriate of potash, MAP and MAP in bulk from the cheapest available source, with a view to dry-blending them and distributing them to the local farmers. The different fertilizers purchased in bulk will first need to be stored separately in individual sheds. When needed they will be reclaimed, mixed in the proportion in which they are required by the local farmers, and subsequently bagged. The resulting mixture should be as uniform as that of a granulated complex fertilizer. A typical small mixing plant with a throughput of 50,000 tons/year costs about \$200,000^{1/} excluding working capital required.

121. Such a plant is a useful first step towards fertilizer manufacture. The market services, distribution system, handling facilities, etc. will all be needed at a later date if it is decided to manufacture fertilizer locally. Therefore the Preparatory Meeting might consider how international co-operation can promote the establishment of such a plant in countries with appropriate market conditions.

1/ Technical details, as well as cost estimates, for setting up a bulk-handling, mixing and bagging plant can be found in UNIDO Monograph No. 2 of the Fertilizer Industry Series.

ISSUE 7

THE PRODUCTION OF ORGANIC FERTILIZERS IN DEVELOPING COUNTRIES

Taking account of the soil-conditioning value of organic fertilizers:

Issue 7 (a) What potential exists for their increased production in developing countries? Can their contribution to total fertilizer production be significantly increased in developing countries?

Issue 7 (b) What measures should be taken by Governments and municipal authorities in developing countries to ensure that optimum use shall be made of opportunities to produce organic fertilizers from urban, industrial and agricultural waste and from other sources such as bio-gas? And in what ways can international co-operation help in the implementation of these measures.

Supporting information for Issue 7 (a)

122. The production of organic fertilizers through controlled composting or the bio-gas process helps to reduce the health and pollution hazards associated with the improper disposal and utilization of organic wastes.

123. At the same time, these processes recover valuable plant nutrients for return to agricultural land. The approximate annual potential availability of plant nutrients from different organic wastes in developing countries has been estimated for nitrogen, phosphorus and potash at 48, 16 and 39 million tons respectively in 1971. The total of 103 nutrient tons potentially available can be compared with 13 million nutrient tons of inorganic (chemical) fertilizers actually used in developing countries in 1971 and the 20 million nutrient tons used in 1965.

124. With this background, the Preparatory Meeting should consider the potential contribution of increased use of organic fertilizer in bridging the gap created by the lack of means of most farmers to purchase sufficient quantities of inorganic fertilizers.

^{1/} The last sentence has been added as compared to the issue listed in the Aide-Memoire.

Supporting information for Item 1 (e)

Production of organic fertilizer from urban waste

125. Composting of urban waste provides the greatest potential for production of organic fertilizers in developing countries. However most cities are hesitant about making extra capital investments which, in effect, require them to go into the business of producing and selling a product in order to accomplish their primary objective namely that of sanitary disposal of accumulated urban wastes.

126. For this reason, the business of composting municipal refuse and sewage sludge would seem to offer good opportunities for private investors, who may be in a better position to deal with problems of market development and sales than municipal authorities. Since the private operator would have to depend on the city for the supply of refuse and sewage sludge, he must have assurance of the continuing supply if he is to invest in a processing plant. Before building a plant he should have a contract or assurance that the city will not decide to change to other disposal methods before the expiration of some reasonable period during which he can recover his capital.

127. Apart from the capital costs of such a plant (US\$ 0,5 to 2,0 million), a considerable initial expenditure is generally needed to improve the efficiency of collection and transportation of the refuse from the entire urban area in order to ensure a regular and adequate supply of raw material for the compost plant. In some cases computer techniques have to be applied to optimize refuse collection and transportation. A substantial additional budget is also needed to maintain adequate manpower and facilities such as garbage bins, garbage collection depots, garbage lorries, and waste handling equipment, as well as workshops for local fabrication and repair of these facilities.

128. Therefore, on this point, the Preparatory Meeting should consider what measures the Government should be prepared to take to stimulate municipal authorities and/or private investors to set up such urban waste composting plants, and whether international co-operation is required.

129. In this connection, should the Government introduce a national scheme for composting of urban wastes and in such cases, will the Government need (a) to introduce legislation for the compulsory composting of urban wastes and (b) to stimulate agricultural research institutes to promote the use of the organic fertilizers thus produced? In what way could FAO assist such development?

Production of organic fertilizer from rural wastes

130. For rural communities with a population of less than 10,000, the organic materials that can be used for rural composting include: various house and farm wastes; animal excrement and manure; harvest residues; various plants such as water-hyacinth, ipomea, weeds, etc.

131. Relatively simple methods are used for rural composting (collection and fermentation pits). Two different techniques have been recommended:

- (i) the simple technique of depositing the materials in a pit (preferable to the heap) combined with natural fermentation after appropriate preparation (shredding, etc.) and possibly the addition of waste water, mineral fertilizers, or night-soil;
- (ii) the more elaborate technique consisting of collecting the materials to be composted and their mechanical treatment in small units, managed on a co-operative basis to the benefit of groups of villages.

132. Since the techniques are relatively simple, they are readily applicable. But like many activities in rural environments, considerable extension activity is required to reach entire farming communities. Investments required for rural composting are relatively limited except in the case of small processing units for the treatment of wastes from groups of villages.

133. However, a serious obstacle to the spread of rural composting could be the limitations of rural transport.

134. With this background in mind, the Preparatory Meeting should consider on this point, what steps Governments should take to encourage rural composting and to what extent international co-operation is required for example, in the development of new techniques.

Production of organic fertilizer using bio-gas technology

135. The technologies for production of biogas from night-soil, animal manure, and other organic wastes such as straw, cane stalks, sawdust, etc. are well known and often have been experimented in some countries (e.g. China and India); they are applicable in other countries with little modification to suit local conditions. Therefore, as a part of its nation-wide rural development programme, the Government may consider the advantages of introducing bio-gas technology in rural areas.

136. Financial support from the Government at national and regional levels will be required through subsidies or loans for the following activities:

- (i) Installation of village latrines where none exists;
- (ii) installation of bio-gas units and provision for complementary domestic equipment (gas burners, etc.);
- (iii) provision of spare parts for the small-scale methane production units;
- (iv) support to extension services to campaign for the collection of night-soil and animal manure, and the installation and use of bio-gas units;
- (v) provision for the maintenance, and wherever possible local fabrication of the equipment.

137. A technology such as bio-gas production may be introduced by a demonstration project organised by UNIDO in co-operation with a developing country where the technology has been well established. A number of demonstration plants could be set up, followed by local fabrication of the equipment and dissemination of the techniques.

138. Therefore, on this point, the Preparatory Meeting should consider how co-operation among developing countries and between developing and developed countries can facilitate the introduction of bio-gas units in the rural areas of those developing countries which request such assistance. The important role which UNIDO can play, in particular as regards fabricating and setting up the necessary equipment, should also be considered, as well as a programme to inform multilateral and bilateral agencies about the opportunity to finance such useful projects.

AREA FOR CO-OPERATION NO. 8

THE INTERESTS OF LABOUR AND TRADE UNIONS
IN DEVELOPING AND DEVELOPED COUNTRIES

Suggestion 8(a) To what extent would a slower expansion of fertilizer production in developed countries and a faster expansion in developing countries cause a significant reduction in employment opportunities in developed countries and increase employment opportunities in developing countries?

139. The interest of labour and trade unions in developing countries lies in the number of employment opportunities created by the fertilizer industry, the type of jobs created and the wages paid. The working conditions offered by the industry, including safety factors, are also important.

140. Labour and trade unions in developed countries have the same interests. In particular, they need to be assured of the continuity of employment in the fertilizer industry.

141. Since the fertilizer industry is expected to expand rapidly in both developing and developed countries, there should be no difficulty in protecting the interests of labour and trade unions in all countries.

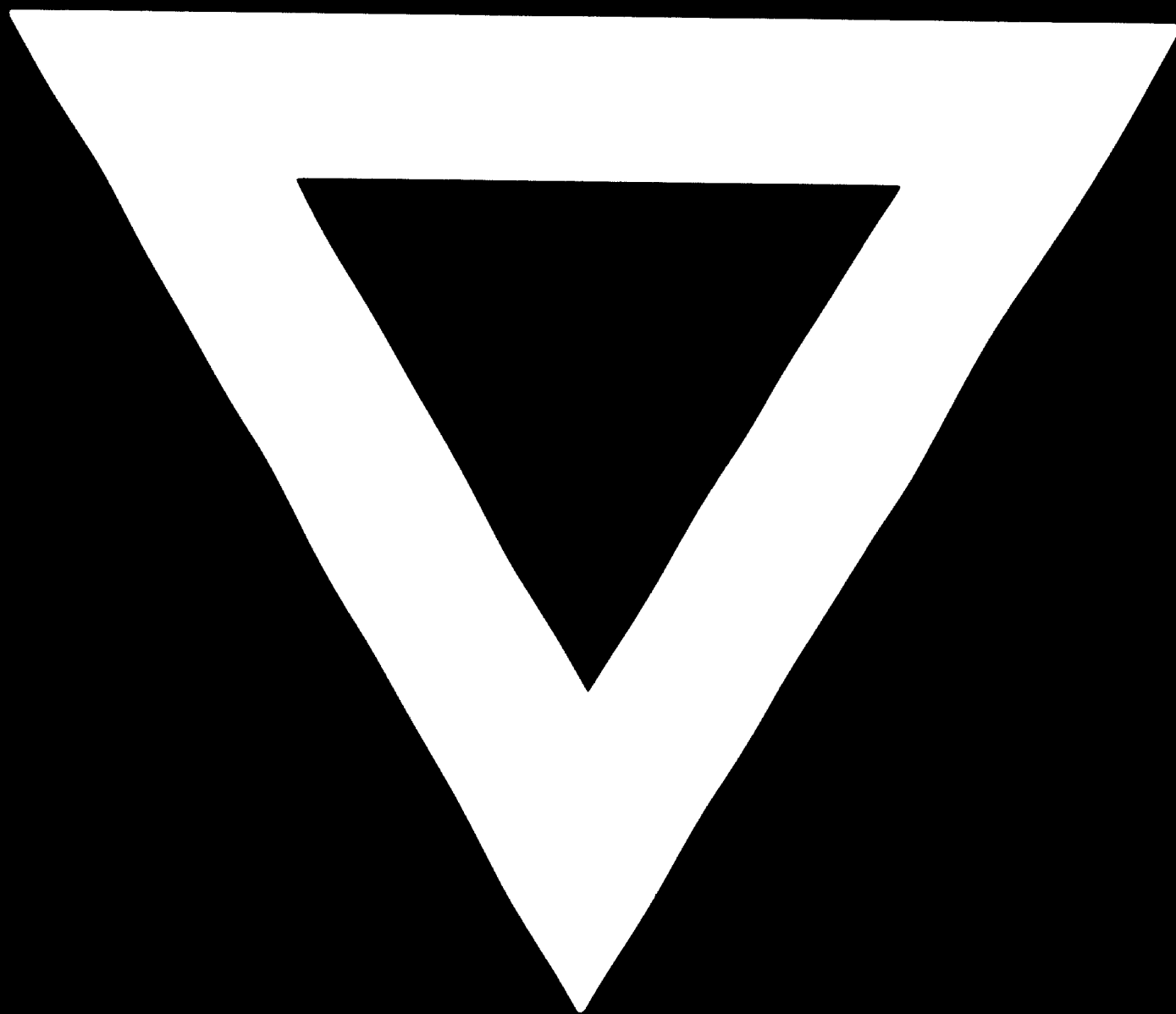
142. In developing countries in the period 1980 to 2000, it is estimated that between 200 and 300 nitrogen fertilizer complexes (each employing about 640 personnel) and between 150 and 200 phosphatic fertilizer complexes (each employing about 480 personnel) will be built. Thus it can be expected that between 200,000 (Case A) and 300,000 (Case B) new jobs will be created.

143. In developed countries in the period 1980 to 2000, it is estimated that between 250 and 350 nitrogen fertilizer complexes (each employing about 400 personnel) and between 140 and 180 phosphatic fertilizer complexes (each employing about 300 personnel) will be built. About 50 of the new nitrogen fertilizer complexes and about 90 of the new phosphatic fertilizer complexes are expected to be plants replacing existing plants where the existing infrastructure will favour construction on the same site. Thus it can be expected that between 100,000 new jobs (Case B) and 150,000 new jobs (Case A) will be created.

144. In this context of a sustained expansion of employment opportunities in both developed and developing countries, there should be no difficulty in protecting the interests of labour and trade unions. Even if the slower expansion of capacity in developed countries is assumed (Case B where developing countries expand more rapidly and export 20 per cent of their production to developed countries in the year 2000), at least 5000 new jobs will be created each year by the fertilizer industry in developed countries as compared to 7,500 under Case A.

145. It is for consideration by the Preparatory Meeting whether these interests should be taken up at the UNIDO Consultation Meeting or in another forum such as the Chemical Industries Committee of the ILO.

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