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Agenda item 3 (d)

**OPPORTUNITIES FOR CO-OPERATION AMONGST DEVELOPING
COUNTRIES IN THE FERTILIZER INDUSTRY^{1/}**

by the UNIDO Secretariat

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INTRODUCTION

1. This background paper for the Consultation Meeting deals with opportunities for co-operation amongst developing countries in the fertilizer industry. This was the last of four topics which the First Consultation Meeting requested UNIDO to examine in depth with a view to reporting results to the Second Consultation Meeting. Experts from 24 developing countries examined this topic at a meeting convened by UNIDO in February 1978. Following this, the author of this paper was asked by UNIDO to develop further some specific proposals for co-operation amongst developing countries.
2. The paper deals briefly at first with the crucial importance of an adequate supply of fertilizers to the national economy and for developing the agricultural potential of developing countries. It notes the imbalance in the fertilizer production capabilities of the developing countries and the developed countries and the need to accelerate the growth in fertilizer production facilities in the developing countries.
3. The raw materials available in the developing countries as a group are more than adequate to meet the expanding needs of their fertilizer industry. However, a mechanism requires to be evolved to effectively share these facilities amongst the developing countries for the benefit of all.
4. The paper notes the low level of capacity utilization of the production facilities that have been set up in developing countries. It identifies opportunities for co-operation amongst developing countries to share experience and facilities for increasing the level of technological skill and competence so as to enable more efficient operation of existing fertilizer plants.
5. The paper examines opportunities for economic co-operation in the development of regional or interregional trade in fertilizers and fertilizer raw materials. It defines concepts and develops plans for co-operation in promoting the use of fertilizers.
6. Finally ways to negotiate co-operative agreement are considered. The problems likely to be encountered are identified and the benefits to be derived from co-operation are assessed. Finally the role of international agencies in promoting co-operation among developing countries is examined.
7. This paper was prepared by Dr. S. K. Mukherjee (India), consultant to UNIDO.

I. IMPORTANCE OF FERTILIZERS IN DEVELOPING THE AGRICULTURAL
POTENTIAL OF DEVELOPING COUNTRIES

8. Agriculture plays a crucial role in economic development; it is the number one priority for most of the developing countries. Self-sufficiency in food production and hence security in food supplies is their major national policy consideration, particularly in countries with a large population and where the rate of growth of population is high.

9. The possibilities to bring additional land under cultivation and thus obtain additional agricultural production is limited in many countries. Besides, the process is expensive and inefficient. Scientific agriculture to increase the yield per hectare of land is the optimum solution and fertilizers play the key role in such a strategy.

10. A review of experience in developing countries in the recent 25 years has established that significant production increase has only been achieved by increased use of fertilizers along with the introduction of fertilizer responsive high yielding varieties. Its use provides the motivation to increasingly adopt scientific farm technology as a way to obtain improved productivity from the land.

11. A review of recent experience in world agriculture, including that in the developed countries also established the soundness of adopting such policies. A recent United Nations study^{1/} noted that:

- In the United States of America, agricultural output per unit of cultivated land has increased by 80 per cent in 1971-1975, as compared to the period 1941-1945;
- In the Union of Soviet Socialist Republics, the average increase has been 70 per cent in 1971-1974 as compared to 1946-1950;
- Japan has attained a 30 per cent increase in rice yield per hectare in the last 30 years from a relatively high yield in the base period;
- In Thailand and the Philippines, rice crop yields were increased by 50 per cent between 1960 and 1970;
- In Mexico, yields of wheat increased 2.2 times between 1960 and 1970;
- In India and Pakistan, average wheat yields were increased by 50 per cent between 1960 and 1970;
- In Syrian Arab Republic, in the five-year period 1970-1975, total agricultural production increased by 50 per cent and the amount of irrigated area doubled.

^{1/} The Future of the World Economy, A United Nations Study by W. Leontief et al., Oxford University Press, New York, 1977.

12. Experience in other countries and the limited experience so far achieved in India does indicate the potential, for example, there ought to be no difficulty for India to produce an additional 50 million tonnes of foodgrains by the use of an additional 5 million tonnes of plant nutrients in the course of the next five years and to nearly double the current cereal output from around 125 million tonnes to 200 million tonnes in the course of the next 15 years, provided supply of essential inputs of fertilizers and pesticides along with water and good seeds is assured.

Fertilizers and soil fertility

Soil fertility

13. Newer technology of plant nutrition and soil fertility permit the farmers to make the most of the growth potential and take full advantage of the favourable climatic factors. Poor soil fertility can, therefore, no longer be accepted as automatically ruling out areas or condemning them to uses of low productivity. Maintenance of soil fertility could be classified into four areas, e.g. (i) by use of basic slag, gypsum and lime as soil amendments wherever required; (ii) by return to the soil in the form of farmyard manure and composts and night soil as much as possible; (iii) by use of legumes and grass as part of the crop rotation in order to add nitrogen and humus; and (iv) by addition of chemical fertilizers.

Soil amendments

14. For India, estimates indicate that 10-15 million tonnes of additional foodgrains could be produced by reclamation saline and alkaline lands by application of gypsum over a 3-4 year period to cover 1 to 5 million hectares of land. The additional production would approximately notionally replace half a million tonnes of nitrogen in the form of chemical fertilizers. Further use of ground lime and/or basic slag at the rate of 2-3 tonnes per hectare once in three to five years in 20-30 million hectares of acid soils will enable the soil to make more effective use of chemical fertilizers. Similar conditions are likely in many other developing countries.

Imbalance in production and consumption between developed and developing countries

15. The consumption of nitrogen as fertilizers in developed countries was 3.2 million tonnes and of phosphates 5.4 million tonnes in 1950. This level of consumption was attained 15 years later in the developing countries in nitrogen and 25 years later in phosphates.

16. Within the developing countries themselves, the production of fertilizers has been consistently below the demand for consumption. Thus in 1965, the production of nitrogen was 2 million tonnes against consumption of 3.56 million tonnes. In 1975, the production was 3 million tonnes against consumption of nearly 11.7 million tonnes.

17. In the developed countries, the production has always and consistently, exceeded the consumption. In 1965, for example, the production of nitrogen was 15.4 million tonnes against consumption of 12.8 million tonnes and in 1975 it was 34.3 million tonnes against the consumption of 27.2 million tonnes.

Low level of consumption in developing countries

18. The per capita consumption of all fertilizers in developed countries has gone up from 17.7 kg in the years 1961-1965 to 52.1 kg in 1974. In developing countries, the corresponding figures are from 2.1 kg and 6.7 kg respectively.

19. The consumption in different regions within the developing countries is as follows:

	<u>Fertilizers used (Kg. per capita)</u>	
	<u>1961</u>	<u>1974</u>
Africa	1.2	3
Latin America	5.3	14
Near East	3.5	9.2
Far East	1.7	5.1

Developing countries dependence on imports

20. In 1974, the production in the developing countries has only been 64 per cent of the consumption. As a result, the developing countries as a group, are net importers of fertilizers; in 1974, the net imports amounted to 7.7 million tonnes of nutrients even when the consumption levels in general are significantly lower than what is required.

Geographical distribution of current status of world production and consumption - regionwise

21. The analysis of recent estimates of world-wide production and consumption of fertilizers in 1976-1977 shows the following important features:

- (a) The dominant position of the three regions, i.e. North America, Europe and USSR altogether account for 76, 76 and 95 per cent of the world production in nitrogen (N), phosphate (P₂O₅) and potash (K₂O), respectively; these three regions also account for 71 per cent of the consumption of the total nutrients (NPK).
- (b) China, Japan and India account for nearly 80-85 per cent of nitrogen and 85-90 per cent of phosphate production in Asia.
- (c) Production and consumption are more or less balance in nitrogen (N) in North America, in phosphate (P₂O₅) in Europe, USSR and Africa and in potash (K₂O) in Europe.
- (d) There are deficits in nitrogen (N) and potash (K₂O) in Africa, Central and South America, and Asia; in phosphate (P₂O₅) in Asia, Central and South America.
- (e) Europe has a surplus in nitrogen (N), North America in phosphate (P₂O₅) and North America and USSR in potash (K₂O).

22. The outlook for consumption in developed and developing countries for the period up to 2000 is examined in the Second World-Wide Study of the Fertiliser Industry prepared by UNIDO for the Second Consultation Meeting.

II. CO-OPERATION TO IMPROVE CAPACITY UTILIZATION OF FERTILIZER PLANTS

Introduction

23. Over the last 25 years, a number of fertilizer plants have been built in the developing countries. Generally, the supply of know-how and technology, engineering, plant, equipment and machinery, services for construction and erection commissioning and start-up has been obtained from the developed countries. Contracts entered into by developing countries for supply of such plants are for a specified production capacity per day. The expectation is that such plants will be capable of operating for 330 operating days in a calendar year at the daily rated capacity. There are instances where number of operating days are higher or lower than the 330 operating days depending on the nature of the technology and design features; but generally speaking, adequate provisions are made in the over-all design of the complex to ensure that the complex as a whole produces the desired product/products of 330 times the daily rated capacity during the year.

24. Experience has shown that some plants after being commissioned do not yield the annual production capacity expected of them. This has been particularly true in the developing countries where capacity utilization on an average has been between

50 per cent and 60 per cent. Sometimes capacity utilization has been in the range of 70 to 80 per cent but rarely has it been above 80 per cent. This is in sharp contrast to the experience in the developed countries where capacity utilization in the range of 70 per cent to 80 per cent are common and there are numerous instances of 90 per cent to 95 per cent capacity utilization over the year (unless, of course, limited by market constraints).

25. The reasons for such low rates of capacity utilization in developing countries are many. Experience has shown that many developing countries face a large number of problems after plants have started up in operation, maintenance and in materials management. Levels of efficiencies attained in all these areas are significantly lower than generally attained in developed countries. This has been the result even in such cases where plants are engineered and built with reliable plant and machinery supplied from the well-known companies from the developed countries. Experience has shown that such results are often due to inadequate planning during project formulation and construction stage.

26. Insufficient attention appears to have been given to the training of an adequate number of skilled operators and technicians. The scope and content of such training programme has often been lacking and the products from such training programmes are found wanting in expertise, information, skill and quickness to react to handle plant situations, etc.

27. The experience needed to draw up an effective preventive maintenance schedule is often lacking; neither is there adequate experience for anticipating the requirement for critical spare parts and materials etc. in time. The need to provide for the necessary spare parts in required quantity and catalysts and critical chemicals is not fully recognized.

28. Adequate maintenance personnel and level of skill required for maintenance are not built up; nor are arrangements made to obtain such expertise in due time. As a result there are delays in maintenance resulting in prolonged shut-down and in consequence a loss of production.

29. The general absence of the development of managers who have sufficient technological knowledge for problem identification and adequate research and development support to initiate corrective action. Hence, the operating results attained are frequently less than optimum. Process efficiencies are poor, resulting in higher costs.

30. The technical co-ordination needed to ensure regular supply of utilities, maintenance of cooling and boiler feed water standards, environmental protection measures, safety aspects has also been lacking in some plants.

31. Sometimes, even within a single country, some fertilizer plants operate better than others. There have been efforts, therefore, to learn from the experience of such efficient plants.

Opportunities for co-operation

32. The opportunities for the developing countries to promote and establish co-operation amongst themselves to tackle some of these problems are immense. The rationale for co-operation amongst developing countries is obvious. Experience of developing countries in these areas are indeed relevant. It would, therefore, be in the interest of the participating countries to confer and to plan to share their expertise, wherever such expertise had been built up. A system of consultation among plant operators to handle specific problems could lead to improved capacity utilization and efficiencies; it will help to raise the technological skill and capacity of the personnel of the fertilizer plants in the participating developing countries.

33. The co-operation amongst the participating developing countries could be extended to share limited resources as and when required. For example a system of co-operation could be developed for borrowing and replacement of spare parts, catalysts, chemicals etc. It would be desirable to approach the problem of provision of spares in a co-ordinated manner. A number of plants in a country could plan to exchange data and establish a system of maintaining an inventory of spares on which in times of need anyone of the co-operating plants could draw. This concept could be extended to a number of plants in a number of neighbouring countries. There are a large number of major and extensive spares for rotating machinery, converter basket, heat exchanger tube bundles, reformer tubes et . etc. which could conveniently be pooled for use by a group of plants whenever needed and a system could be developed for replenishment of the inventory in due time. An approach of this type would contribute to significant savings in the inventory of spare parts. This system would also ensure a ready availability of spare parts than can be expected from the original manufacturers even in times of emergencies.

34. Co-operation could also extend to: supplying the services of experts in time; a continuing interchange of experience amongst participating plant owners; periodic conferences at various levels; a regular exchange of visits amongst participants' personnel at critical operation and maintenance levels.
35. A system could be developed for the exchange of notes recording on experience on matters relating to safety, maintenance and operation problems, suggestions from plant personnel for improvements and results attained therefrom. Conferences at top management levels to review results and take corrective action in time could also be arranged.
36. An effective programme for mutual assistance, to facilitate consultations with other plant owners and to share skills and resources needs to be established. Such a programme will help one country to develop the technological skills of another country.
37. The cost of expatriate personnel required for the annual/bi-annual overhaul of critical machinery has now become prohibitive. Often, annual maintenance jobs could not be precisely planned and it becomes difficult to obtain vendors' servicemen in time to fit in with sudden changes of schedules for undertaking annual maintenance work. A group of neighbouring countries could take the initiative to specifically provide opportunities for development of expertise and train a group of men to become experts to replace as far as possible vendors' servicemen from developed countries.

III. CO-OPERATION IN SETTING UP NEW FERTILIZER PRODUCTION FACILITIES

38. There is an urgent need to set up new production facilities in the developing countries where fertilizers are required to increase agricultural production. In planning such facilities, a developing country has much to gain if it was to seek co-operation from other developing countries and share the financial and raw-materials resources, market, available human skills, and availability of hardware and construction materials.
39. The international development agencies are expected to play a more positive role both in fostering and financing such co-operative ventures. It is also possible for the participating countries to provide for arrangements to "buy-back" of the products in exchange for services provided and materials. Such co-operation arrangements among developing countries will help to reduce the external finance that might otherwise be required from international financial institutions and from other sources.

40. When UNIDO convened a meeting of an Expert Group in February 1978, to discuss how regional co-operation amongst developing countries might be achieved, specific opportunities to establish a number of specific projects were identified as follows:
- (a) A plant using natural gas available in Bolivia to produce nitrogenous fertilizer for the markets of Argentina, Brazil, Paraguay, Uruguay and Bolivia;
 - (b) The possible development of potash deposits in Bolivia and Chile to satisfy the needs of other Latin American countries;
 - (c) The planned development of phosphate deposits in Peru to supply the market of other Latin American countries;
 - (d) The phosphate fertilizer project planned to be established in Senegal for West African markets;
 - (e) A nitrogen fertilizer plant for West African markets planned to be established in Nigeria;
 - (f) Possible co-operation to utilize phosphoric acid from Senegal and ammonia from Nigeria to produce complex or blended fertilizers on-the-spot in other West African countries;
 - (g) Possible co-operation that would use fertilizer intermediates supplied by countries in North Africa to produce fertilizer on-the-spot in certain land-locked countries in Africa;
 - (h) Co-operation between Bangladesh, India, Pakistan and any other country in the region with the aim of optimizing economic utilization of resources and skills.

The examples given above are only illustrative and many more useful projects could be identified for the Consultation Meeting to consider by the participants from developing countries.

41. A country with a potential for agricultural development could provide the market to absorb a major part of production from a proposed fertilizer production facility leaving an option for the remaining part to be marketed either in a second participating country or to be sold in international trade. The second country could be one that can provide the principal raw materials. An economic feasibility study could reveal the optimum location for establishing such a facility in either one of the two countries. A plant based on natural gas might be best located at the source of gas, whereas one based on naphtha could be located in either one of the two countries.

42. Resources of phosphate rock in the developing world are largely in the North-African countries, whereas the demand exists for phosphate fertilizers in all developing countries. Currently, the limited demand resulting from the low level of

consumption of phosphatic fertilizers in developing countries is met largely from the United States of America and for rock-phosphate and intermediates like, phosphoric acid from the United States of America, Morocco, etc. Opportunities, therefore, exist for developing countries that are large producers of phosphate rock and countries that are large consumers of phosphate fertilizer (either without or with limited raw-materials resources of their own) to co-operate to set up production facilities.

43. The phosphate complex based on phosphate rock and sulphur could be located in a country where either both raw materials or rock phosphate is available. In the case of phosphate complexes, where the market for the products are exclusively in one country, it is also possible to consider to locate it in that country with rock phosphate and/or sulphur being supplied by the other partner country. In cases where the phosphate complex is dependent on phosphoric acid, the location will naturally be in the country where market potential exists with supplies of phosphoric acid being obtained from the partner country having the raw material resources. Some idea of the opportunities that exist can be obtained from the matrix of international trends in phosphates shown in Table I.

44. There are a large number of small developing countries which require supplies of a small quantity of fertilizers to help modernize their agriculture. Opportunities exist for international action to foster co-operation amongst a number of such small developing countries to set up regional production facilities at locations where raw materials are available for production. A small developing country can seldom justify setting up production facilities for its own needs. These small countries, however, do need a dependable local source of supply of fertilizers. If a regional plant were established under an arrangement where all participating countries were involved in the financing, production and marketing of the products, then all participating countries could derive benefits through appropriate arrangements to share resources and skills.

45. Conversely without such an arrangement, it is unlikely that these small developing countries will have to rely on imports of fertilizers with the prospect of fluctuations in supply and prices from time to time.

Different forms of co-operation

46. The illustrative examples given above envisage co-operation amongst two developing countries as investment partners. A variant of this model is that an undertaking could be owned exclusively by one country but develop economic co-operation with

another country in specific areas. This approach would be particularly attractive for such countries where demand has already attained a sufficiently high level but will still require the support of another country to provide a market for a marginal quantity of production initially for a limited period until domestic demand develops to absorb the full capacity potential. This form of co-operation could take place where one country will supply fertilizers and, in exchange, obtain some other products as for example, raw materials/packing materials for the fertilizer complex proper or even for other products not necessarily linked with the operations of the fertilizer plant.

47. A country with a strong raw material position and financial resources could also set up production facilities of its own and enter into a long-term contract to supply fertilizers in exchange for agricultural products which the country buying the fertilizer might be able to provide. Such forms of co-operation would be particularly valid for the countries in the Middle East where resources for raw materials and finances are available but potential for agricultural production is limited. In such cases, co-operation could be established with the countries having rich agricultural potential.

48. There are examples where demand levels have developed adequately to establish an economically viable facility, but raw materials or some raw materials and/or intermediates are non-existent. In such instances, a study of alternative policy options is likely to lead to a choice for setting up of domestic production with imported raw materials/intermediates in preference to imports of fertilizers. The important criteria to determine the issue is the level of demand that has already been attained or is likely to be attained within a short-time framework, say five years or so. In such cases, the production facilities could be shared with another neighbouring country for a short period as had already been discussed earlier.

49. Such arrangements of setting up of production facilities and sharing for a limited period between two countries will not only eliminate uncertainties in supplies but provide for impetus to expanding use of fertilizers which will result in higher agricultural production. Experience has shown that market development efforts, more particularly the creative aspects of market development, are considerably accelerated if there is a domestic production facility or regular supplies are assured from a specific pre-determined source. When supply is based on imports, with all the uncertainties generally associated with international trade, there is inadequate motivation for stimulating an expansion in fertilizer use; usage is restricted to highly

remunerative crops by relatively rich farmers often with total disregard for the needs of the country for food grains and other agricultural products.

IV. CO-OPERATION IN THE PLANNING AND CONSTRUCTION OF NEW FERTILIZER PROJECTS

50. The planning and construction of new fertilizer plants in developing countries presents problems which are different from those experienced in developed countries. There are major areas of differences influencing construction schedule, provision of utilities, infrastructure facilities, type of construction used etc. There are also major areas of differences of design philosophy, approach to instrumentation, capacities for intermediate and furnished product storages and provision of installed spares for critical pumps and machinery. Design features often have to include provisions to operate with multiple feedstocks such as, for example, naphtha and/or natural gas. Ambient conditions are often different from those encountered in the developed countries requiring alteration in engineering standards and specifications. Design provisions have to allow for skills and facilities for maintenance that are different from those available in the developed countries. Electric power supplies are often not as reliable as could be expected in developed countries. Such aspects need to be identified during the initial planning stage and adequate provisions must be made to meet reasonable contingencies.

51. These illustrative examples show that for planning and construction of modern fertilizer complexes in developing countries, the experience of other developing countries become more relevant than that of developed countries. Recognition of this fact leads to the logical choice to seek co-operation from other developing countries who might have had opportunities of experience in the planning and construction of fertilizer plants. It would be desirable that such co-operation arrangements are established at an early stage of conceptual planning and throughout the successive steps in implementation, e.g., preparation of feasibility reports, preparation of project reports and project estimates for investment decisions, selection of site, preliminary surveys for provision of infrastructure facilities, surveys for determining soil bearing strength, collection of meteorological data, etc. Project reports on which an investment decision is taken, often adequately covers the manner of implementation of the project.

52. Following such broad guidelines, co-operation could be sought in the various steps that are required during the pre-contracting stage inclusive of preparation of documents for "request for bids" and steps required to pre-qualify a selected list of contractors for the invitation to bid for the project. The project reports also provide for detailed studies on market development and related marketing aspects, e.g., requirements for promotion and extension facilities for market development, infrastructure facilities required for effective marketing such as warehousing, dealership network etc.

53. The evaluation of the bids, negotiations for contract and preparation of contracts documents are also complex areas. The supervision of the contract and construction management activities and training of project planning personnel for over-all costs and schedule control or other areas where experience of other developing countries might be relevant.

54. During construction, assistance of other developing countries to act as consultants for providing comprehensive services on all aspects of the project inclusive of inspection and start-up will be of assistance both to the owner as well as to the contractors.

55. Co-operation with another developing country in the capacity of a consultant for comprehensive services or an adviser for limited services is desirable in all these areas of planning and construction of the projects beginning with conceptual planning to commissioning, start-up and production stabilization i.e., until one year after production has been established.

56. The contribution which another group in a developing country could make to a developing country who might not have had opportunities for acquiring such experience is of inestimable value. Arrangement for such co-operation will invariably be made on commercial lines but with an added emphasis on the concept of co-operation between developing countries. This aspect is indeed of importance as often it is possible to meaningfully associate international agencies such as UNIDO, in these efforts. Further such co-operation amongst developing countries in the form of commercial contracts often takes place with knowledge and concurrence of the Governments of these countries and as such, assistance from Governments becomes available if it becomes necessary.

V. CO-OPERATION IN THE ESTABLISHMENT OF TRAINING
FACILITIES FOR THE FERTILIZER INDUSTRY

57. Training is very often given inadequate attention in the developing countries. The consequences of not having suitably qualified and trained personnel to operate and maintain a plant are rather severe. Training facilities provided by the industry for acquiring experience in the industry will become effective only if a supply of adequately qualified manpower in required numbers are available to the industry.

58. Fertilizer industry is technologically complex and requires high level of technical competence of scientists, technologists and engineers to successfully handle the problems. Technicians for operation and maintenance must also have the necessary background to attain the level of skills that are required to man shop floor jobs. Agricultural scientists and economists play an important role in educating farmers and opinion leaders to attain success in the use of products. Management of these undertakings requires men with sound background knowledge in relevant disciplines.

59. Scientists, technologists and engineers with adequate background knowledge and experience could only develop the necessary analytical ability for problem identification. Only such knowledgeable persons could absorb the complexities of the technologies for identification and solution of problems in the areas of technical management, technical services, research and development, cost reduction etc. Technicians required for operation and maintenance must also have the background to acquire the skill and appreciation of the day-to-day problems that would confront them.

60. The foregoing provides in brief an outline of the prerequisites of the type of manpower that are required in the fertilizer industry. Educational facilities are required to provide opportunities for acquiring knowledge and skill in the relevant disciplines and trade. Such disciplines include courses on basic sciences, technologies and engineering; in finance, economics and in information sciences. Institutions providing facilities for studies involving such curriculae are required. Trade schools for training of technicians are an essential part of such facilities.

61. Manpower suitably qualified and trained, in such institutions require further training in the industry. The Training Plan within the industry involves on-the-job training for periods between 18 months to 5 years for different categories of personnel.

62. Young men from trade schools could be taken as apprentices under such a training plan by the industry for developing skills in them for ultimate use as craftsmen, technicians e.g. fitters, welders, electricians, riggers, etc. These training facilities require class-room lectures and workshop facilities for basic training followed by on-the-job training in the regular workshops and along with plant maintenance personnel in an operating plant.
63. The supervisory trainees are given training on-the-job for not only doing the job themselves but also providing in them the appreciation of the requirements for supervisors.
64. The existing employees from an operating plant could be taken off their regular duties periodically to provide refresher courses. Training aids, required for such refresher courses, are many but simulator training has been found to be effective for chemical plant operators.
65. The middle level managers are given training in relevant aspects of the job. It is also important to expose the middle level managers both on the technical and on the commercial side to interact with others in the industry in training programmes, seminars etc. periodically.
66. In these activities, there are tremendous opportunities for co-operation amongst developing countries. Many developing countries have established extensive training institutes for training of various categories of personnel that are required for the fertilizer industry.^{2/}
67. In India, for example, in each of the major public sector plants, there are training establishments which at one time could handle between 200 to 1,200 trainees of different categories. These training establishments are having separate facilities for laboratories, workshops, class-rooms, audio-visual aids, simulator training aids, etc. exclusively for use in the training department. The workshops are equipped with facilities for handling problems that are actually encountered in the maintenance of plants as, e.g. in instrumentation maintenance etc. These establishments have their full time faculty members. Additionally, part-time members are drawn from the industry.

^{2/} See the offer at the end of the paper entitled "Training of personnel for start-up and operation of a new fertilizer plant" by P. T. Pupuk Sriwidjaga (P. T. Pusri), Jakarta, Indonesia (ID/WG.281/1).

Each of such training establishments are attached to a factory and trainees are given on-the-job training in suitably prepared training plans which are different from each category of trainees. Often, even, within a category the training period and content is too varied to provide opportunities for individuals to acquire the skill required on actual jobs.

VI. CO-OPERATION IN THE DISTRIBUTION OF FERTILIZERS AND PROMOTING EXPANSION OF THE USE OF FERTILIZERS

68. An element of co-operation could take the form of assistance given to countries with a rich agricultural potential to help them modernize their agriculture. It involves promotion and extension activities on a scientific basis that encompass transferring the technology of farming to the farmers relevant to the conditions of the specific country. These are complex areas as agro-climatic conditions, soils and crops differ from country to country and also from different regions within a country. The promotional aspects for scientific development of agriculture require high level expertise and the programme is expensive.

69. It would be useful to establish co-operative arrangements between developing countries who have attained success in expansion of fertilizer use through such programmes and introduce them in other developing countries. There are instances where such a programme has been facilitated by providing grants and aid in the form of fertilizers and the sale proceeds of which in the recipient country are used exclusively to provide resources for promotion and extension activities and for development of infrastructure facilities for fertilizer marketing.

VII. OVERCOMING PROBLEM AREAS RELATING TO CO-OPERATION AGREEMENTS

70. Experience has shown that the concept discussed in the preceding paragraphs have only been translated into commercial plants in a limited number of cases. The problems associated with establishment of such co-operative ventures are many. It is however, possible to deal with such problems if fundamentally the need for development of co-operation is recognized. It is also fundamentally important to remain realistic and to recognize that any co-operative agreement becomes only possible where substantial benefits accrue to each one of the participants in different forms.

71. A positive over-all approach is required to view the problems instead of limited short-term gains from a commercial angle. For example, one of the participants might be interested in buying products on a long-term basis. In such a situation the buyer and/or the seller will often find it difficult to justify agreeing on long-term supply/price commitments if discussions are restricted for possible gains or losses from a limited commercial angle on the specific transactions. Many points could be raised which would tend to cast doubt about the desirability of such long-term contracts and the possibility of such contracts acting adversely for one party or the other. It, therefore, becomes necessary to approach the long-term contracts from the point of view of development of co-operation for an assured regular supply/market for products. An enlightened policy based on broad judgement has to be adopted to ensure success.

72. Countries with raw-materials resources often have expectations for high prices even where other options for use of such inputs are not always available, e.g., an agreement in pricing basis has often been difficult for natural gas which normally has otherwise been flared or even, in some cases, where prospects of use of natural gas for other purposes, at least for some years to come, are normally not significant.

73. The infrastructure requirements for successful operation of this complex facility involving high technology are invariably inadequate; as such, the fertilizer project itself might have to plan for providing these facilities. Transportation, utilities and facilities for shipment are often lacking to meet the requirements of a major complex. Services and facilities for construction, operation and maintenance often present problems to the planners of such complexes. All these constraints lead to a high capital outlay, which sometimes, appear to make the project financially less attractive, more particularly, from the points of view of profits, returns on investment, investment/output ratio etc.

VIII. THE FORMULATION AND NEGOTIATION OF CO-OPERATION AGREEMENTS

Pre-requisites for success

74. An essential pre-requisite to the success of a co-operative venture is obviously the spirit of co-operation amongst the participants to attain quick results. Such efforts will facilitate if the number of parties in the agreement could be kept down to a minimum; in fact, the optimum arrangements might be bilateral discussions between

the two countries where there could be deep and meaningful involvement of both the countries in the areas of purchase of raw materials, market of products and generally stimulating development in industry and trade. These desires by the parties might reflect in equity participation by both in suitable proportions. Such financial participation in equity interests of the undertaking between the two partners will establish creditability. Policy formulation and managerial decisions must also be worked out together as true partners for the success of the venture.

75. United Nations agencies could play a catalytic role in initiating consultations and involving meaningful participation of international financing agencies such as the World Bank and other agencies. The fundamental concept behind such co-operation is to share the facilities and market prospects that are available with the two countries and to ensure that each of the partners positively profit from such ventures.

Components of co-operation in fertilizer construction and operation

76. The technological competence and skill required to successfully operate a facility ought to be developed exclusively from within these partner countries; and more particularly, as far as possible, from the country where the facility will be located. The technical services and other supporting facilities involving high technological skills might initially be purchased for a period of time on a contract basis through technical collaboration agreements (and not financial participation) separately if possible from another developing country if such facilities are not adequately developed either in one of the two partner countries. For limited technical services, it might also become necessary to have limited arrangements with suitable developed countries.

Steps in the formulation of a co-operation agreement

77. The important steps in evolving an economic co-operation agreement ought to be identified and the two partners might jointly agree to implement them within an agreed specified time frame. The first of such steps would be to prepare and execute a "Formation Agreement". Such an agreement might provide for establishment of a company managed by the two partner countries. Accredited nominees of the partner countries will constitute the Board for managing the proposed undertaking.

78. Once such a company is formed, the next step will be to have two or three recognized experts in the company's payroll preferably and as far as possible drawn from other developing countries. The management with the assistance of these experts could

develop the broad specific contours of the project and take steps to select a consultant for preparation of a project report. The involvement of an international financing agency at this early stage is very desirable. The project report so prepared with the participation of the company management and international financing agency would be the basis for an investment decision.

79. Concurrently, the company might initiate steps for establishing the source and the pattern of financing inclusive of source for loan financing. These two steps i.e., the project report and determination of the source of finance and broad agreement in principle between the company and financing agencies will lead to an investment decision.

80. Once this step is attained the project implementation group should become operational. This group, with the assistance of consultants wherever necessary, formulate the detailed steps for the manner of implementation of the project. Depending on this, steps are required to be initiated for selection of engineering contractors and for sources of supply of plant, machinery and construction services. Concurrent with the contract and construction arrangements, steps are required to be initiated for identification and recruitment of personnel and for their training for operation and maintenance of the factory. The project implementation group might also concurrently and continuously review the steps for co-ordination with various agencies who would undertake to supply the infrastructure facility required for the project.

Commercial contracts for raw materials and products

81. The commercial contracts involving purchase of raw materials and sale of products would have to be entered into by the company so constituted and under the broad guidelines that will be set out in the Formation Agreement itself. The parties to such commercial agreements might be government departments or government owned controlled companies or between privately owned companies where the government might have to play the regulating role in terms of the Formation Agreement.

Co-operation with a third developing country

82. An expanded concept of economic co-operation could take the form of a purchasing agreement with a third country and for supplies from facilities resulting from economic co-operation amongst two other developing countries. This will help promote

co-operation amongst the developing countries within a region or even interregional, and would help to eliminate external dependence on this vital sector. Such third country co-operation could also take the form of understandings in other areas relevant to the planning, construction, operation, training, marketing, etc.

IX. SOME BENEFITS OF CO-OPERATION AGREEMENTS

83. The benefits of such economic co-operation are many. It ushers in an environment of development of national technological capacity and skill and promotes effective transfer and development of high level technology and hardware. Such efforts promote optimum utilization of human, natural, industrial and agronomic resources and to stimulate continuous expansion of an adequate technology base. This leads to promoting technical co-operation and interchange of experience and knowledge in all aspects.

84. In any event, the approach to such co-operative efforts should aim at promoting sound and viable fertilizer production facilities which could effectively compete with fertilizer supplies from other sources. This is possible despite many handicaps that the developing countries have to face. The competition is frequently strong because of the low cost of maritime transport available to well established traditional trading groups. Besides competition has to be faced often, against marketing techniques and strengths from well established traditional sources. Examination of these factors are necessary in the planning stage for the developing countries with a view to eliminate or to reduce the adverse impact of such possibilities or take a realistic view to insulate oneself from any unfair competition which in any event is short lived.

X. THE ROLE OF INTERNATIONAL AGENCIES IN PROMOTING CO-OPERATION AMONGST DEVELOPING COUNTRIES

85. Bearing in mind the recommendation of the First Consultation Meeting on the Fertilizer Industry that UNIDO should examine potential areas of co-operation between developing countries, UNIDO convened an Expert Group Meeting on Regional Co-operation among Developing Countries in the Fertilizer Industry in Vienna in February, 1978. At this meeting a number of documents were considered; they are listed in annex A.

86. The meeting took note of co-operation efforts made in the past such as the joint venture between government corporations in Colombia and Venezuela. Other examples of co-operation reviewed were the participation of Arab countries in financing fertilizer plants in Pakistan, Egypt, Jordan, Sri Lanka and Bangladesh. The group also noted that agreement in principle had been reached by the ASEAN Group of countries to set up two fertilizer plants; one in Indonesia and the other in Malaysia to serve the regional markets. In West Africa, an export oriented plant to produce phosphatic fertilizers had been planned by the Government of Senegal in co-operation with a national company and a number of outside partners. The efforts of other regional groups towards co-operative ventures were also noted.

87. International agencies are willing to provide services to support such efforts at co-operation. A Technological Advisory Service has been initiated by UNIDO to assist developing countries in negotiations for technology, engineering, and know-how contract. UNIDO's Industrial and Technical Information Service and UNIDO's Manual on Fertilizer Industry^{3/} are also useful sources of information for the developing countries.

88. The UNIDO/FAO/World Bank Working Group on Fertilizers, meets annually, inter alia, to review the fertilizer production, supply and demand for different regions of the world. The information it produces is most helpful for those planning new fertilizer projects in developing countries. UNIDO is also considering the possibility to resume publication of the directory of fertilizer producers in developing countries. If this information were disseminated widely on a regular basis it would facilitate increased co-operation amongst the developing countries in planning new fertilizer facilities.

89. When it comes to co-operation on the construction of plants, UNIDO's Model Forms of Contract for the construction of typical fertilizer complexes will, when completed, be most useful to developing countries.

90. UNIDO is keen to support co-operation initiatives such as the Arab Federation of Chemical Fertilizer Producers (AFCFP) and the Association for the Development of the Fertilizer Industry in Latin America (ADIFAL).

^{3/} A revised edition is scheduled for publication in 1979.

91. UNIDO has helped promote development of co-operation in the fertilizer industry at the subregional level in Central America, in the ANDEAN group of countries and in the ASEAN group of countries.
92. A Regional Fertilizer Information and Advisory Service sponsored jointly by ESCAP/FAO/UNIDO aims, inter alia, to promote co-operation amongst countries in ESCAP region. Annex B gives details of the project. So far six Asian countries (Afganistan, Thailand, the Phillipines, Iran, India and Bangladesh) have officially confirmed their support for the project.
93. A Regional Survey of the Fertilizer Industry in Arab States was made jointly by UNIDO/UNDP/AFICFP/IDCAS in 1976/1977. A group of 9 experts visited a number of Arab countries. The survey included a review of (a) fertilizer projects, (b) their technical manpower and training needs, (c) environmental protection measures, (d) fertilizer distribution and marketing, (e) agricultural research. A Regional Survey was made for the ESCAP Region in 1975.
94. Another joint study has been made by UNIDO/IDCAS/ECWA on the Development of the Fertilizer Industry in Arab States. This study covers the period of development up to 1985 and deals with prospects for additional production facilities and the potential for trade in nitrogenous and phosphate fertilizers in the Arab countries.
95. IDCAS is convening a meeting in October 1978 to review this study. At a subsequent conference in November 1978, a long term collaborative programme for the development of fertilizer production, distribution and trade in Arab States will be discussed. The programme is sponsored by UNIDO, UNDP, IDCAS and AFICFP.
96. The World Bank is developing a model to permit examination of alternative plans for determining the optimum choice of locations, capacity and other parameters for specific projects. It has been used in considering plans by the ANDEAN group and other countries or groups of countries. The International Fertilizer Development Center (IFDC) has made surveys in subregions or regions of Asia, Africa and Latin America.
97. The Secretariat of the Central American Common Market, SIECA, had prepared studies examining 29 alternatives for production facilities in two or three of the member countries. They will be discussed at a meeting in October 1978.

98. Under the auspices of the Action Programme on Fertilizers of the Latin American Economic System (SELA), a multinational organization called "LASIFERSA" has recently been created to develop regional co-operation in the construction and operation of fertilizer plants. The functions of LASIFERSA are described in annex B. The functions of a similar new multinational company are described in annex C.

ANNEX A

THE EXPERT GROUP MEETING ON REGIONAL CO-OPERATION AMONGST
DEVELOPING COUNTRIES IN THE FERTILIZER INDUSTRY,
VIENNA - 8-10 FEBRUARY 1978

List of documents

- ID/WG.265/1 Regional co-operation in the fertilizer industry. The experience and potential of the ANDEAN Group of Companies
- ID/WG.265/2 Co-operation in the fertilizer industry: The experience of the Arab Federation of Chemical Fertilizer Producers
- ID/WG.265/3 Co-operation amongst developing countries in the fertilizer industry. The experience of Pakistan as regards financing two fertilizer plants
- ID/WG.265/4 Regional co-operation in the fertilizer industry: Experience and opportunities in Latin America
- ID/WG.265/5 The potential for co-operation in the nitrogen fertilizer industry in Latin America
- ID/WG.265/6 Bilateral and regional co-operation among developing countries in the fertilizer industry: Experience in India
- ID/WG.265/7 Suggested areas of co-operation among developing countries in the fertilizer industry - UNIDO Secretariat
- ID/WG.265/8 Posibilidades de Integración en el Sector Fertilizantes del Grupo Andino - Algunos Trabajos de JUNAC al Respecto
- ID/WG.265/9 Investment planning in the fertilizer industry: Research and applications at the World Bank
- ID/WG.265/10 Posibilidades de Desarrollo de la Industria de Fertilizantes en Centroamérica

ANNEX B

FUNCTIONS OF THE MULTINATIONAL ENTERPRISE FOR ENGINEERING
ADVICE AND SERVICES ON THE FERTILIZER INDUSTRY
(EMPRESA MULTINACIONAL LATINOAMERICANA DE
ASESORÍA Y SERVICIOS DE INGENIERÍA EN
FERTILIZANTES) (LASIFERSA)

LASIFERSA was set up by the Action Programme on Fertilizers established by SELA.
It will have the following objectives:

1. To promote an efficient regional production on fertilizers and raw materials, under a plan of co-operation and regional complementarity in order to reach the productive auto-sufficiency and if possible to eliminate the external dependency of this sector.
2. To reach as soon as possible, the optimum use of the existing natural resources, the actual installed capacities, its enlargement or the establishment of new plants.
3. To develop co-operation amongst the countries in this area, to get an adequate and efficient planning in the country.
4. To contribute to an efficient transfer of technology which will permit the best utilization of human, natural, industrial and agronomic resources existing in the region and to stimulate the creation and development of an adequate technology for the region.
5. To promote the standardization of design and equipment especially in the new oriented projects to the amplification of the regional productive capacity.
6. To promote technical co-operation and interchange of experiences and knowledge about design, construction, operation and maintenance of plants.
7. To contribute towards the best utilization of fertilizers in the sector of agro-industries of Latin America, favourable to the interchanges of experiences on investigation and extension of methods and capability amongst the participating countries.
8. To establish training programmes for the technical and administrative personnel of the plants.

(Cont'd) ./.

ANNEX B (cont'd)

SIEMENS will also realize:


1. Feasibility studies
2. Basic licence and engineering
3. Specific engineering
4. Construction and assembling
5. Running of the plant
6. Operations and maintenance

ANNEX C

FUNCTIONS OF THE MULTINATIONAL LATIN AMERICAN ENTERPRISE
FOR THE DEVELOPMENT OF COMMERCE IN FERTILIZERS

Considering that the establishment of the multinational enterprise for the development of commerce in fertilizers will take some time before being operative due to the administrative steps of approval needed by each country, the Acting Committee had recommended that a Trade Co-ordination Unit be established.

The objectives of the Trade Co-ordination Unit of commercialization are as follows:

1. To promote interregional trade in fertilizers and raw materials adjusted to the possible deficits and surplus of each country.
 2. To support the negotiations in each area adopting acquisitions and sales of raw materials and fertilizers, either in a global or in an individual basis.
 3. To maintain a permanent interchange of information between the member countries related to supply and regional and international market conditions; emphasis is being given to prices and availability of raw materials and transportation of the fertilizers.
 4. To promote a spirit of co-operation between the member countries through their activities, accelerating the process of regional integration.
 5. To fight the disloyal practices in the international commerce and to neutralise its effects.
 6. To set up a practical basis and to get experience which will permit a future constitution of the multinational enterprise for the development of commerce in fertilizers.
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