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ID/WG.281/5
28 September 1978

ENGLISH

United Nations Industrial Development Organization

Second Consultation Meeting on the
Fertilizer Industry

Innsbruck, Austria 6-10 November 1978.

Agenda item 5 (b)

INFRASTRUCTURE REQUIRED FOR THE PRODUCTION AND DISTRIBUTION OF FERTILIZERS

Background Paper
by the UNIDO Secretariat

This paper deals with: the estimated investment cost of establishing different items of infrastructure; the demarcation of responsibility for establishing such infrastructure between (a) the Government and other public authorities and (b) the fertilizer producing enterprise; and the terms and conditions appropriate for financing such infrastructure investments

This document has been prepared without formal editing.

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TABLES

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Agenda Item (6)

INFRASTRUCTURE REQUIRED FOR THE PRODUCTION AND DISTRIBUTION OF FERTILIZERS

Corrigendum

Page 8, paragraph 20, line 2

After meet the insert requirements of a project. It is common practice in many

Page 12, footnote 1

The first sentence should read

Natural gas used as fuel and for steam and power generation in the plant costing $US 2 per thousand (standard) cubic feet

Page 16, paragraph 36

Line 1: for paragraph 35 read paragraph 35

Line 3: at the end of the line insert $56

Line 4: for $14 to $28 read $13 and $28

Page 17, paragraph 41, line 1

At the beginning of the line after and insert taxes

Page 17, footnote 1, last line

For cost read price

id. 78-6061

Page 21, paragraph 44, lines 5, 10 and 17

For paragraph 7 read paragraph 8

Page 45, line 1

For marketing read marking

Page 46, paragraph 120, line 8

For inter-governmental read intra-governmental

Page 46, paragraph 125

Line 2: for form read from

Line 3: for that part read their part

Page 51, paragraph 138

Line 1: for by read for

Line 2: for Paker read Parker

Footnote 1: for risk read role

Page 52, lines 8 and 29 and page 53, line 3

Delete PM in the left column

INTRODUCTION

1. The Report of the First Consultation Meeting on the Fertilizer Industry considers infrastructure in paras 26 to 34. Paragraphs 29, 30 and 32 reas as follown:

> "29. The Meeting recognized that the absence of an infrastructure should not be allowed to inhibit decisions to set up plants. On the other hand, the Meeting felt that the setting up of plants would assist in the over-all economic development of less developed areas and would stimulate the creation of an infrastructure."

> "30. Considering the costs involved in establishing an infrastructure and the need to produce fertilizers cheaply so that they would be within the reach of the farmer, the Consultation Meeting was of the view that it would not be correcto to expect fertilizer projects to bear the total costs of infrastructure. There was a need to define and demarcate clearly those items of infrastructure that should fall within the responsibility of the State and public authority and that should consequently be financed from the public exchequer, and items of infrastructure which were directly associated with fertilizer projects."

> "32. The Consultation Meeting felt that the demarcation must be so arranged as to reduce, as far as possible, capital costs in fertilizer projects and, consequently, total production costs.

2. Under the sector dealing with follow up to the Meeting, paragraph 69 read as follows:

> "69. The Consultation Meeting, bearing in mind the importance whioh it attached to the establishment of an infrastructure in developing countries, requested the UNIDO Secretariat to prepare a detailed document on the infrastructure required for fertilizer plants.

3. The purpose of this paper is:

(a) to identify the different items infrastructure required for the production and distribution of fertilizer and the investment required for establish them;

(b) to consider the demarcation of responsibility for establishing such infrastructure between the fertilizer enterprise and the State of other public authorities; and

(c) to suggest terms and conditions appropriate for financing such infrastructure.

4. Part A of the paper discusses the infrastructure needed by a fertilizer plant. Part B is a case study of the infrastructure required for nine fertilizer plants built in one developing country.[1/]

5. Part C of the paper considers the different items of infrastructure needed for the distribution of fertilizers. Part D is an illustrative case study of the total investment cost of the infrastructure required to distribute 300,000 tons of fertilizer materials.[2/]

1/ Parts A and B are based on a paper prepared by Mr. S. Sundar acting as consultant to UNIDO.

2/ Parts C and D are based on a paper prepared by Mr. J.M. Boudewijn acting as consultant to UNIDO.

CHECK-LIST OF THE INFRASTRUCTURE REQUIRED FOR THE PRODUCTION AND DISTRIBUTION OF FERTILIZERS.

6. The Report of the First Consultation Meeting (paragraph 26) classified the infrastructure requirements of the fertilizer sector as including:

(a) Transportation infrastructure (roads, railways, port facilities, railway rolling stock, ships etc.)

(b) Utilities infrastructure (power supply, water supply, and a drainage and effluents disposal system)

(c) Raw material infrastructure (critical raw material inputs, supply of feedstock)

(d) Marketing infrastructure (storage facilities, and distribution net work)

(e) Infrastructure of Agriculture Extension Services and Modern Agronomic Practices.

(f) Human infrastructure (entrepreneur skills, managerial skills, maintenance and operation skills)

(g) Policy infrastructure (the board framework of government plannings, laws, and pricing and economic policies)

To this list should be added "Social Infrastructure" which would include housing amenities, hospitals, schools, recreational facilities etc.

7. The above categorisation of infrastructure would cover the requirements of the entire fertilizer sector. The items of physical infrastructure requiring capital investment are listed in table 1. This is an attempt to provide a complete check-list of all items of infrastructure that may be required.

TABLE 1. CHECK LIST OF THE INFRASTRUCTURE REQUIRED FOR THE PRODUCTION AND DISTRIBUTION OF FERTILIZERS

INFRASTRUCTURE REQUIRED FOR THE PRODUCTION OF FERTILIZERS

1. Utilities

- Captive power supply
- Connection to public power supply
- Water supply
- Drainage and effluent disposal system
- Site for fertilizer plant
- Communications systems

2. Workshop facilities for heavy maintenence

3. Transportation infrastructure

- Roads
- Railways including marshalling yards
- Port and unloading/loading facilities
- Road vehicles, railway rolling stock, ships for transporting raw materials

4. Raw materials infrastructure

- Treatment facilities for raw materials such as beneficiation plant for phosphate rock or gas treatment facilities.
- Pipeline for supply of gas, fuel oil or naptha
- Off-site facilities for handling and storing raw materials

5. Human infrastructure

- Basic education facilities
- In-plant and on-the-job training
- External training courses in plant operation and maintenance

6. Social infrastructure

- Houses
- Schools
- Hospital and medical facilities
- Other public buildings and recreational facilities

INFRASTRUCTURE REQUIRED FOR THE DISTRIBUTION OF FERTILIZERS

7. Marketing infrastructure

- Storage facilities for distribution to farmers
- Local blending plants
- Storage facilities for fertilizer for export
- Road vehicles, railway rolling stock, ships for distributing fertilizers

8. Agricultural extension infrastructure

PART A. THE INFRASTRUCTURE REQUIRED FOR THE PRODUCTION OF FERTILIZERS

I. ADDITIONAL ITEMS OF INFRASTRUCTURE OFTEN REQUIRED BY A FERTILIZER PLANT IN A DEVELOPING COUNTRY

8. The infrastructure items required by a fertilizer plant in a developing country which add to the total investment required to establish it, can be considered in the following categories:

(a) "On-site" facilities which form part of the project cost.

(b) Infrastructure relating to "off-site" facilities but located within the battery limits of the fertilizer plant.

(c) Infrastructure facilities required to support the operation of a fertilizer plant located outside the battery limits of the plant.

9. Infrastructure items in the first category are normally attributed to the project to establish a fertilizer plant. As a general rule, the facilities required in a developing country are more extensive than in a developed country. For example, workshop facilities, particularly for heavy maintenance, are usually more extensive in developing countries; in developed countries such facilities would usually be available close to the site. Similarly, warehousing and storage requirements for spare parts and other supplies have to be far more extensive in developing countries.

10. Infrastructure items in category (b) includes facilities such as railway marshalling yards, road despatch facilities, associated road links located within the plant site. In developing countries, both rail and road facilities are usually provided in case one or the other service fails. In developing countries, the public power supply authorities may sometimes ask the fertilizer project to accept power supply on transmission voltage and provide for transformer and switch gear facilities at the cost of the project.

11. Infrastructure items in category (c) consists of a range of supporting services such as port and harbour facilities, rail road and marshalling yards, power supply up to project site, water supply up to project site, township and other amenities etc. In developed countries, hardly any capital costs are incurred by the fertilizer project authorities on items of infrastructure under this category whereas in developing countries, the fertilizer project is often expected to bear the cost of some of these items of infrastructure.

II. DEMARCATION OF RESPONSIBILITY FOR PROVIDING INFRASTRUCTURE FOR THE PRODUCTION OF FERTILIZERS

12. Part II considers which items of the infrastructure listed in Table 1 form an integral part of the fertilizer project and should be provided at the cost of the project and which items of infrastructure it should be the responsibility of public authorities or the State to provide.

Utilities Infrastructure

13. The power supply system for a fertilizer complex has four major components:

1. Power generation
2. Power transmission
3. Overall system design in power generation, power transmission and facilities at the power supply point to the consumers.
4. Arrangements for the reception of power and distribution at different voltages within the project.

Any deficiency in any one of the above areas would severely reflect on the power supply characteristics to the fertilizer complex. Reliability in power supply not only in terms of adequacy but also in terms of stability is essential for the smooth and safe operation of a project.

14. The cost of power generation, power transmission and overall system design of the facilities up to the point of power supply to the fertilizer complex should be borne by the Electricity Authority. A fertilizer project is entitled to the same treatment as any other bulk consumer of power and there is no reason why a project should be required to bear the cost of extending the transmission line to the project site. The extension of transmission arrangements to make power available at the boundary of the fertilizer plant would help in generating demand for power for agricultural and other uses, en-route. The cost of arrangements for reception of power and distribution within the project, including facilities for stepping down the voltage to the levels required for different duties within the project, should obviously be at the cost of the project itself.

15. Instability in the generation and transmission of power is characteristic of developing economies. Often times, therefore, it becomes necessary to provide for captive power generation facilities in a fertilizer complex to protect the sensitive equipment from the unstable power supply characteristics of a cental grid. A captive power plant with a capacity for the generation of about 15 to 20 MW could cost about $ 15 to $ 20 million. This is an item of infrastructure not required in developed countries. Being an additional capital cost to the fertilizer complex imposed mainly on account of the instability in the general power supply system, it could be argued that the entire cost of captive power generation facilities should be borne by the public exchequer. However, since a captive power generation facility is essentially a part of the fertilizer project and is integrated with the steam system on the basis of a total energy concept, it would not be possible for an external agency to own the facility. As an alternative, therefore, it would be necessary to make funds available for a captive power generation facility on soft terms. It would also be necessary for the State to accord to the captive power generation facility in a fertilizer project, such fisoal and other concessions as are available to Electricity companies.

16. The requirement of water supply for a fertilizer plant is usually met either through an irrigation source or a natural water stream like a river. It may also become necessary in some cases to make additional arrangements such as the construction of a dam or a reservoir to ensure adequate availability of water through out the year. As in the case of power, the cost of arranging for adequate supply of water up to the boundary limits of the project, including the construction of dam-reservoir or other facilities necessary to augment water supply, should be borne by the service agency. Any arrangement required within the project for storing a certain minimum days requirement of water as an insurance against any possible disruption in the supply should be at the cost of the project. Here again as in the case of captive power generation facility, financing for the construction of a reservoir within the plant premises should be on soft terms.

17. **As regards the drainage and the effluents disposal system,** the responsibility for treating the effluents and bringing down the level of treated effluent at the point of discharge, to the standards prescribed by the various pollution control authorities in a country should lie entirely with the project authorities. Further arrangements for the discharge of the total effluent from an industrial area should be at the cost of the exchequer. The cost of facilities for monitoring the levels of pollution outside the projects should also be borne by the Public Authority.

18. **The land required for the construction of the fertilizer** project should be at the cost of the project. Government assistance would, however, be required to acquire the land at reasonable rates for the project so that the project authorities are not required to pay an exhorbitant price, which, becomes inevitable in direct purchases.

Transportation Infrastructure

19. **The development of railway, roads, port facilities, ships** etc. would be essential for the successful implementation and operation of a fertilizer project. The creation of such facilities would also generate the growth of industries and commerce in the area, and secondary and tertiary employment. It should, therefore, be the responsibility of the public authority to take on the cost of development of the transportation infrastructure as may be required for a fertilizer project.

20. **It usually becomes necessary to extend the railway line** from a port or a main railway line to meet the developing countries for the railway authorities to lay and maintain the railway line at the cost of the project authorities although the ownership of such a line would best with the railways. Considering, however, the additional cargo and revenue that would accrue to the railway system from a fertilizer project not only railway lines up to the limits of a plant but also the track facilities within the project should be borne by the railway authorities.

21. **The development of port facilities as are necessary** for receiving and despatching ships should be at the cost of the port authorities. Any specific arrangements as may be required in the port for unloading and storing fertilizer raw material or for despatching fertilizers should also be at the cost of port authorities or stevedore companies.

Raw Material Infrastructure

22. **In most developing countries, the exploitation of raw** materials like rockphosphate and sulphur and the production of feedstock like natural gas, naphtha, fuel oil, etc. are **made** at the cost of the State of concerned agency and not at the cost of the fertilizer project. It is not the normal practice in developing countries for fertilizer projects to have captive facilities for the production of raw material-feedstock. The arrangements for the supply of raw material-feedstock, including storage in transit, are, however, not uniform and are either at the cost of the supplying agency or at the cost of the fertilizer project or a trading agency. As a matter of policy, it would be desirable if fertilizer projects are required only to provide storage within the project itself to maintain the minimum required inventory. In developing countries, even the inventory provision for raw material and feedstock has necessarily to be higher as compared to developed countries as the lead time for the delivery of imported raw material is long; provision has also to be made for break-down in supplies arising out of transportation and transhipment problems.

Human Infrastructure

23. **The fertilizer industry is a high technology industry** requiring competent scientists, technologists and engineers at varios levels. Skilled technicians are required for plant operation and maintenance. Agricultural scientists and economists are needed to educate farmers in the use of fertilizers and in modern agricultural practice.

24. While it would be for the project authorities to provide the necessary facilities for imparting the specific training and know-how required for the various services in a fertilizer complex, the manpower recruited by the industry should have a basic academic training in order to be able to absorb the specialist training given by the project authorities. The consequences of not having suitably qualified manpower from the educational institutions are rather severe. Training facilities provided by the industry for acquiring experience in the industry would be successful only if adequate qualified manpower in required numbers is continuously made available to the industry.

25. An infrastructure of educational facilities is, therefore, required to provide opportunities for acquiring knowledge and skill in the relevant disciplines and trades. Such infrastructure facilities should include adequate provision for training in different disciplines of sciences, technologies, engineering and trades; in finance, business management and in information sciences.

26. The cost of providing the basic educational infrastructure must be that of the state while the cost relating to specific in-plant training should be borne by the industry itself.

Social Infrastructure

27. As a matter of public policy it would be desirable if with the setting up of large industries, industrial townships that provide housing for a fairly large percentage of the total number of employees and civil amenities like hospital, schools, shopping centres, recreation facilities etc. are established. The provision of township and other facilities will not only ensure that critical personnel are available to a project when required but would also provide for better labour relations. Quite apart from this, the provision of township and facilities alongwith large projects in a developing country in turn results in the development of well planned housing and urban development. The growth of a township would also in turn generate growth in the surrounding areas by way

of creation of trades and crafts to meet the requirement of the residents of a township and additional employment opportunities. In short, the development of township and associated facilities as part of the project is really a fulfillment of an objective of State policy viz. the provision of good housing for industrial labour. Appropriately, it would be for the public authority or the Urban Development agency to provide the initial capital cost ot the township, leaving it to the project authorities to pay the rental or acquire the facilities on a deferred payment basis.

28. Urban development Authorities and Project Authorities should also envolve schemes to provide financial assistance on soft terms to the staff and workers of a project to construct their own houses in the project area/township. Such a scheme would result in reducing the burden both on the Public Exchequer and on the project authorities and at the same time would ensure that at-least a section of the staff and workers have the satisfaction of owning their houses. In long term, the successful implementation of such a scheme would ensure that the work force in contended and would arrest mobility.

III. THE IMPACT OF THE COST OF INFRASTRUCTURE ON THE COST OF FERTILIZER PROJECTS AND THE COST OF PRODUCTION.

29. The capital costs of fertilizer plants, particularly ammonia/urea complexes, have a significant impact on the cost of production. The element of such fixed costs constitutes about 60% of the cost of production. Initial capital investments for a fertilizer complex in developing countries is generally higher than in developed countries, in part because of additional infrastructure costs.

30. A recent World Bank paper 1/ estimates the cost of investment in a gas-based ammonia/urea plant producing 1650 tpd of urea in developed countries and developing countries as under:

	Cost ($ Million)	Ratio
Plant in developed country	157	1
Plant in developing country	240	1.52
Plant in developing country (remote location)	335	2.13

The data contained in the paper demonstrate the impact of project cost, including the cost of infrastructure, on the cost of production of fertilizers in developing countries.

31. Table 2 of the paper, reproduced from the World Bank's paper, compares the cost of establishing a fertilizer plant in a developing country and in a developing country (remote location) with the cost of establishing a similar plant in a developed country. When the individual components of costs as between the plants in the three different locations are compared, it can be seen that the cost of machinery, equipment and spares as well as the cost of engineering (including design erection and licence fees) are not significantly different.

1/ "Investment and Production costs for Fertilizers" prepared by Mr. William F. Sheldrick, Chief, Fertilizer Unit, World Bank and presented at the Fourth Session of the FAO Commission on Fertilizers in Rome in September 1977.

TABLE 2. ESTIMATES OF THE INVESTMENT COST OF ESTABLISHING IN THREE LOCATIONS A PLANT PRODUCING 1650 TPD OF UREA BASED ON NATURAL GAS

(all units in US $ millions, 1977 prices)

	Developed country (site with infrastructure)	Developing country (site with some infrastructure)	Developing country (remote location)	Barge[2] Mounted Plant
1. Land, site preparation and civil works, including roads, drains, workshops, buildings etc.	4	12	14	-
2. Machinery, Equipment and Spares	83	90	98	83
3. Freight and Insurance	3	12	20	11
4. Engineering Charges including design, erection, licence fees etc.	30	40	50	59
5. Off-sites and other expenses including start-up fees, housing amenities etc.	16	30	55	9
6. Barges	-	-	-	53
7. Mooring Buoy	-	-	-	12
	136	184	237	227
Price, physical and site contingency	14	46	83	23
Plant investment	150	230	320	250
Working capital	7	10	15	15
Total investment	157	240	335	265

1) Tonnes per day
2) Based only on preliminary investment cost estimates

Source: World Bank Estimates, August 1977

32. Significant variations in costs occur mainly in the case of land, site preparation and civil works including roads, drains, workshops etc. The costs in respect of these items at sites in developing countries are three times the cost in a developed country. The variation in the cost of off-sites and other expenses including housing amenities etc. and the contingency provision for physical and site factor are double the developed country costs in a developing country and four times (an additional $39 millions) if a remote location is chosen. The cost of freight and insurance on the plant and equipment that has to be imported and transported to inland is also considerable higher.

33. The assumptions is made in the World Bank Paper that most of the infrastructure already exists in a developed country; in a developing country some fertilizer and social infrastructure is available and in a remote location of a developing country, there is hardly any infrastructure available. The differences in the total cost of investment therefore appears to depend significantly on the different cost of infrastructure required in the three types of location.

34. It appears that whilst the necessary infrastructure in developed countries is provided by external agencies, in developing countries it is charged as part of the total investment cost of the project. If, as a matter of social and economic policy in developing countries, the cost of infrastructure required for a fertilizer project were to be borne by the State or an agency external to the fertilizer project, there could be a significant reduction in the cost of investment and consequently in the cost of production. Alternatively, where it is not possible for the State of an External agency to bear the entire cost of infrastructure, even the sharing of the cost between the State and the project authorities on an equal basis would reduce the project's cost significantly.

TABLE 3. ESTIMATED COST OF PRODUCTION OF UREA AT THREE LOCATIONS

U.S. Dollars per metric tons.

(1)	Developed Country Case A (2)	Developing Country (some infrastructure) Original Cost Case A (3)	Developing Country (some infrastructure) Reduced Cost Case B (4)	Developing Country (some infrastructure) Reduced Cost Case C (5)	Developing Country (remote location) Original Cost Case A (6)	Developing Country (remote location) Reduced Cost Case B (7)	Developing Country (remote location) Reduced Cost Case C (8)
INVESTMENT COSTS							
Plant Investment (US $ millions)	150	230	180	205	320	213	266
Working Capital (US $ millions)	7	10	8	9	15	10	12
Total Investment (US $ millions)	157	240	188	214	335	223	278
PRODUCTION COSTS PER TON OF UREA							
Cost of raw materials 1/	70	70	70	70	70	70	70
Other variable costs US $	12	12	12	12	12	12	12
Fixed costs US $	46	63	53	58	81	59	70
Production costs US $	128	145	135	140	163	141	152
Profit with 15% ROI US $	48	73	57	65	102	68	85
Ex-factory price US $	176	218	192	205	265	209	237

ASSUMPTIONS FOR EACH PLANT

Production Capacity: 1650 tpd/bagged urea; 330 days/year production; hence 544,500 tons urea annual capacity; capacity utilisation of 90 per cent = annual out put of 450,050 tons.

1/ Natural gas used as fuel and for steam and power generation in the gas costing US $2 per lt.st.cu.ft.

The price of this unit of gas varies from country to country in the range of $0.35 to $2. A variation in the gas price of US $0.1 will result in a variation in the production cost and realisation per ton of urea by about $3.5. A uniform gas price of $2 has been taken in order to high-list the impact of variations in the capital cost of the project on the cost of production.

Case A. Based on the estimates of the World Bank.
Case B. When additional infrastructure is provided by public authorities.
Case C. When additional infrastructure is shared by the project and public authorities.

35. The World Bank estimates suggest that an additional investment of $ 83 million in a developing country and $ 178 million in a developing country (remote location) is required to establish a fertilizer plant that cost $157 million in a developed country. Assuming, for the purpose of this discussion, that 60% of the additional investment is on account of the need to provide infrastructure (and that the rest is on account of other factors such as site conditions, civil works, start up fees etc.) then the cost of the project could be reduced by almost $ 50 million in a developing country and by about $ 100 million in a developing country (remote location) if the total cost of infrastructure is borne by the State or an external agency. If the cost of infrastructure is shared equally between the project and the State, the cost of the project would be reduced by about $ 25 million in a developing country and about $ 50 million in a developing country (remote location).

36. In Table 3 the estimates of the World Bank have been used to show the reduction in the cost of production that would flow from the reduction in the capital cost of the projects by adopting either of the two policy alternatives discussed in para. 38 above. It can be seen from the statement that if the cost of infrastructure were to be borne entirely by the State, the reduction in the price of urea per tonne would be $ 26 in the case of a developing country ($192 instead of $218) and in the case of a developing country (remote location)($209 instead of $265). If the additional cost of infrastructure were to be shared equally between the State and the Project Authorities, then the corresponding reduction in the price per tonne of urea would be $14 to $28 respectively.

37. The cost saving calculated above on the basis of the World Bank estimates are only indicative. They have been used here to demonstrate the importance of reducing the impact of the cost of infrastructure on the cost of production of fertilizer in developing countries. The cost of infrastructure and its impact on the project cost and cost of production will naturally vary from country to country.

38. The actual cost of infrastructure for nine plants build in one developing country are analised in Part B. They suggest that infrastructure costs average 10 per cent to 12 per cent of a project's cost (20 per cent if captive power supply is required) compared to perhaps as much as 18 per cent to 24 per cent in the World Bank estimates. 1/

1/ This comparison is not an accurate one as the World Bank's paper provides no breakdown of what it calls:

"Offsites and other expenses including start-up fees, housing amenities etc."

"Price, physical and site contingency"

The figures quoted assume that infrastructure acoounts for only 60 peroent of costs under these heads. (see para. 35 above)

IV. GOVERNMENT POLICY ON THE FINANCING OF SUCH INFRASTRUCTURE.

39. The prices paid by farmers for agricultural inputs such as fertilizers and the prices realized by farmers for their produce have a decisive influence on expansion of fertilizer usage. It would, therefore, be necessary to ensure in developing countries that the cost of fertilizers are within the reach of the average and marginal farmers and that their use becomes remunerative for the farmers. Fertilizer prices could be kept low either by reducing the capital cost of a project and, thereby, the cost of production or through fertilizer subsidies. It would seem more advantageous to reduce the investment cost of the project rather than allow the additional investment in infrastructure to be reflected in the cost of production and then have the cost of fertilizers subsidies throughout the life of the plant.

40. Government intervention in the fertilizer sector is widespread in most developing countries. Intervention can be direct such as investment approvals, price controls, subsidies, tariffs or may be indirect such as exchange rate manipulations etc. Government policies in developing countries should be basically designed to remove constraints in the use of fertilizers and to improve efficiency in fertilizer use. Government policies should also be designed towards setting up fertilizer capacity with the minimum possible investment.

41. For example, Governments in developing countries, should as a matter of policy avoid imposing tariffs and duties on the import (or local manufacture) of fertilizer plant and equipment and on the employment of expatriate personnel required in the implementation of fertilizer projects.

42. It would also be advantageous for developing countries if national and international financial institutions were to provide investment funds for the fertilizer industry on soft terms and conditions that are the same as those applicable to projects in the agriculture sector.

43. In the specific area of infrastructure, sound government policies should include the following two principles:

a) As a matter of policy, in developing countries, the choice of location for a fertilizer project should be left to the dictates of the factors of location. There would be no particular advantage in locating fertilizer projects in backwards areas on grounds of regional dispersal of industries and development of backward areas as fertilizer projects are not labour-intensive. If, however, a fertilizer project is deliberately located in a backward area in order to stimulate the development of that area, then the additional cost of infrastructure on account of the location should, as a matter of policy, be borne entirely by the Public Exchequer. 1/

b) When a fertilizer project is appraised and the financing arrangements are made, it is the usual practice for the financial institutions, both national and international, to obtain adequate guarantees from the local authorities/ agencies not only that the required infrastructure facilities will be made available for the fertilizer project in due time but also that they will be financed by the authorities. However, the financial assistance provided by the institutions normally does not cover the cost of infrastructure facilities which are to be provided at the expense of the local authorities/ agencies. National and international financial institutions should agree to cover the requirement of funds for the development of infrastructure facilities specific to the project at the same time as they agree to provide financing for the project itself. The funds could be provided either directly

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1/ Adding to the cost of aproject as a result of a decision to locate the project in a backward area would also be counter productive inasmuch as the increased projeot cost would be reflected in the cost of production. This in turn would either necessitate the farmers in the backward area paying a higher price for fertilizer or in Government granting a higher subsidy to keep the cost of fertilizer low.

b) to the local authorities/service agencies or if the local requirement do not permit this to the project itself. The provision of funds for the development of infrastructure facilities should be on soft terms,2/

2/ It has been the experience of many countries that as the implementation of the project proceeds, local authorities/ service agencies, who had earlier agreed to provide funds and make the infrastructure available for the fertilizer project, find themselves unable to do so. In consequence, the project is required to make substancial funds available to the local authorities/service agencies merely in order to ensure the required infrastructure facilities are available in time for the project. This in turn results either in an over-run in the project cost or in the need to obtain additional loans at higher rates of interest.

V. CONCLUSIONS AND RECOMMENDATIONS

44. The Second Consultation Meeting may therefore wish to consider the following conclusions and recommendations:

a) The cost of "On-site" facilities (Category (a) in paragraph 7) should form part of the project cost;

b) A substantial portion of the cost of infrastructure relating to "Off-site" facilities (linking the plant to existing utilities, to roads and rail etc.) (Category (b) in paragraph 7) should be borne by the State of other public authorities;

c) The cost of infrastructure facilities required to support the establishment and operation of a fertilizer complex such as port, road, rail, utilities, housing etc. (Category (c) in paragraph 7) should be borne by the State or other public authorities;

d) Sufficient financing should be arranged at the outset to cover both the cost of the fertilizer plant and the associated infrastructure required for establishing and operating the plant;

e) The finance provided for infrastructure facilities to be developed by the State or another public authority should be provided on terms and conditions as favourable as those provided for agricultural projects (that is on soft terms);

f) In exceptional cases, where the fertilizer plant is neverthless required to provide supporting infrastructure facilities at the cost of the project, then the terms and conditions of the financing provided for such infrastructure facilities should be as favourable as those provided for agricultural projects (that is on soft terms);

g) Governments, national and international financial institutions should support the above recommendations and do all in their powers to implement them.

B. A CASE STUDY OF THE FINANCING OF THE INFRASTRUCTURE REQUIRED BY NINE FERTILIZER PLANTS IN ONE DEVELOPING COUNTRY

45. This study is a case study of the cost and financing of infrastructure facilities in 9 fertilizer projects in a developing country, with a view to identifying the impact of the cost of infrastructure on the project cost and measures for effecting reduction in project costs. Data relating to nine projects studied are contained in Table 4.

46. A brief description of the Country's policy in regard to the location of fertilizer projects, financing of projects and of infrastructure facilities would lead to a better appreciation of the discussion relating to the various projects.

I. Location of Projects

47. As a matter of policy, the choice of location for fertilizer plants in the Country has generally been determined by techno-economic considerations such as the proximity to sources of feedstock, availability of infrastructure, proximity to areas of consumption, etc. While some of the plants are located in backward areas, the choice of location in these cases has been determined not by socio-economic considerations of backward area development but on grounds of either proximity to feedstock or proximity to consumption areas. Various schemes for the development of backward areas include the provision of infrastructure facilities and other concessions to attract industries. There are Area/Industrial Development Agencies in the various Provinces in the country to plan the location and development of industries and to provide infrastructure facilities in a coordinated manner.

II. Financing of Fertilizer Projects

48. The financing of fertilizer projects in this country differs from plant to plant depending upon whether the

the plant is owned by the State, private entrepreneurs or jointly by the State and private entrepreneurs or cooperatives. The State owned projects are normally financed with a debt equity ratio of 1:1. Project loans given by the State usually carry an interest of 10 per cent per annum. Projects in the private and joint sectors were in the earlier years normally financed with a debt equity ratio of 2.5:1. In view, however, of the tremendous increase in the magnitude of investment in fertilizer projects after the oil crisis in 1973-74 and the difficulties faced by entrepreneurs in raising funds of the magnitude required, the debt-equity ratio in the case of fertilizer projects has been stretched to 3.5:1. The promoters of a project are generally expected to provide 10 per cent of the project cost by way of equity. The Institutional Financial Agencies and Commercial Banks under-write the remaining portion of the equity and also arrange for the long-term loans required for the implementation of the project. Project loans given by the Institutional Agencies ussually carry an interest of about 11 per cent and the loans given by the Commercial Banks, an interest of 13 per cent. All loans given for a fertilizer project normally have a grace period of three years.

III. Demarcation of responsibility for establishing and financing different types of infrastructure facilities

49. In the Country financing arrangement for a fertilizer project include also the financing of infrastructure facilities, forming part of a project. There are no separate norms or terms and conditions for the financing of infrastructure.

Utilities Infrastructure

50. As a matter of policy in the Country the generation of power, the supply of water through the construction of dams, reservoirs or aqueduct are made by the concerned service agency. The arrangements, however, for the laying of power transmission lines from the main line or a generating station to the project site are not uniform.

In many cases, the project authorities have been required to take the power up to the project site at their cost. Similarly, the arrangements for laying pipeline or constructing canals to take the water from the main source to the project site is often required to be done at the cost of the project.

51. The inadequate availability or instability in the supply of power in certain sectors in the Country has made it necessary for fertilizer plants to have captive facilities for the generation of power to meet the critical requirement of the front end plants. The project authorities are required to bear the cost of captive power generation in all cases.

Transportation Infrastructure

52. The Country has considerably advanced facilities for transportation including major and minor ports, railways, highways, etc. The development of ports, rail-heads, rail wagons, ships, high-ways etc. are borne by the Public Authority or Sercice Agency. Plants have been located almost always in close proximity to existing transport infrastructure facilities.

53. The cost of taking a railway spur from the main railway line or marshalling yard to the project site is usually required to be borne by the project authorities in this country. Freight for the transport of cargo is, however, charged from the main railway line or marshalling Yard. Similarly the cost of laying roads to the plant site from the main roads or highways is borne by the Project Authorities.

54. The railway wagons used for the transportation of raw material and finished products are owned and maintained by the rail-road companies. The arrangements in respec of ships are similar.

55. In the Country the responsibility for supplying raw material and inputs is not with the fertilizer companies but with other agencies. Normally the arrangements for storage and transport of raw material and inputs up to the plant site is done at the cost of the supplier. The fertilizer projects are required only to provide for storage facilities within the plant. Where, however, the fertilizer company is directly arranging for imports of raw material and has, therefore, to provide for port handling and storage facilities, the cos of such facilities is required to be borne by the fertilizer project.

Marketing infrastructure and infrastructure of Agricultural Extension

56. The down-stream infrastructure for the sale and distribution of fertilizers is provided by agencies external to the fertilizer projects. Warehouses and field godowns are constructed and operated by Warehousing Corporations, which rent out space for fertilizer storage. The retail and distribution channels are operated either in the cooperative sector or by private trade. Fertilizer projects are not required to incur capital expenditure on warehousing and marketing.

57. The Public Authority in the Country expends considerable resources on Agricultural Extension Services. The fertilizer companies are also required to provide Agricultural Extension Services as part of their marketing operation. There is close coordination between the fertilizer industry and the public authority in agricultural extension.

Human Infrastructure

58. The country has considerably advanced facilities for education, including technical education required for the operation of chemical plants. The Public Authority takes the responsibility for providing basic education and trade skills for a large category of industrial requirements. Specific in-plant training for technicians required for the

operation and maintenance of a fertilizer project is provided at the cost of the project.

Industrial Infrastructure

59. The Country has a large industrial base and has facilities for the manufacture of plant and equipment, engineering goods and materials for civil and structural works.

IV. Case study of infrastructure required by the nine fertilizer plants

60. The items of infrastructure considered in this paper pertain only to the physical infrastructure required specifically for the implementation and operation of fertilizer projects and not the cost of facilities like ports, rail roads, ships, warehouses etc. It does not also include the cost of industrial and human infrastructure. This would have to be borne in mind while comparing the cost of infrastructure in fertilizer projects in Country and with the likely cost of infrastructure in less developed countries, where many of the items that are provided by public authority in Country may be required to be provided as part of fertilizer projects.

61. The projects in Exhibit I have been brought under three categories, depending upon the cost of infrastructure. This has been done in order to facilitate an appreciation of the reasons for the differences in cost.

Plants located at a developed site

62. Project A is on the outskirts of a large city. The fertilizer plant is also adjacent to a Refinery belonging to the same shareholders. As a result, the refinery and the fertilizer project have been able to share the cost of certain infrastructure facilities, especially the supply of power and the railway siding facilities. Water and roads have been made available to the company by the public authority without any capital cost to the project. Also

being in a city, the project has not considered it necessary to have a township. Instead, the Project Authority has a scheme for giving loans on soft terms for house construction to its employees and several of the company's employees own their own houses in the city. The company has also hired houses in the city for some of its employees. As a result, while the company has been able to provide housing to a large percentage of its employees, the company has had not to incur any capital expenditure on township and other amenities.

63. Project B is in fact an expansion of an existing plant. Although, the project is located in a remote inland location, which is also backward, the cost of infrastructure for the expansion plant was limited to the minimum additional facilities required. This case would indicate that the expansion of an existing fertilizer plant would call for a lower investment on the development of infrastructure facilities as compared to a plant in a grass root location.

64. Project C is at a port location in a backward area. As part of the Area Development Porgramme, arrangements for the supply of water and power to the fertilizer project were made at a cost of a little over US$5 million by the concerned service agencies. The extension of the railway line up to the plant site was also done at the cost of the Railways. The expenditure on infrastructure in case of this plant was restricted mainly to land and land development, township and amenities and roads. Had the project been required to bear also the cost of the water, power and railway connections, the cost of infrastructure would have been about US$12.7 million as against the cost of US$ 5.61 million actually incurred, resulting in an increase of about US$ 5 in the cost of production per ton of urea. The company, however, had to incur an expenditure of about US$ .30 million for the construction of a Ram in the harbour for unloading heavy equipment as the major port was not ready in time to receive equipment for the fertilizer project. The port has been developed at the cost of port authorities.

Plants located at undeveloped sites

65. Project D, E and F are State-owned projects in grass root locations. These projects have had to incur an expenditure of roughly 5 to 6 million dollars on items of social infrastructure like township and amenities. The cost of township and amenities has been financed by the State entirely by way of equity. This has been done on the ground that the project should not be required to incur financing charges on the cost of township and amenities, which are essentially social amenities. The projects are, however, expected to service the equity invested on the township out of their earnings. These projects also had to make arrangements at the cost of the projects to carry water and power up to the project site, as also to take the railway connection.

66. Project G is located in a large industrial city. As a result, the company has not found it necessary to provide and social infrastructure such as township and amenities. The company, however, has a policy for giving loans on soft terms to its employees for constructing houses. On the other hand, the company has had to incur substantial expenditure on railway facilities as the company had also to provide for additional facilities within the limits of the railway station to cater to the increased traffic due to the fertilizer project. Considering the additional cargo that the project has generated, this expenditure on the development of yard facilities in the Railway Station should have been provided by the railway authorities and not by the project.

Plant requiring captive power supply

67. The percentage cost of infrastructure in Project H is as high as 20 per cent mainly on account of the fact that the project has also captive facilities for power generation. The project has also had to incur expenditure on raw material handling and storage facilities at the port. The feedstock

for the production of nitrogen and phosphates in this project are transported trhough pipelines from the port. As a result, the expenditure in this project on railway facilities is comparatively low.

68. Project J is an industrial area. The infrastructure cost for this project is high mainly on account of the captive power generation facilities now being set up. While in the case of project H where the captive generation facility was set up along with the project on the basis of the total energy concept, in the case of project J, the decision to set up a capitve power generation facility was taken three years after the project went into production. It was, therefore, not possible to integrate the steam requirement of the captive power generation facility with the steam balance of the project itself. This would also prove the point that some of the facilities could be had at a lower cost if they were planned along with the project.

V. Conclusions

69. The above analysis and the data in Table 4 would indicate that in projects located on a developed site or where a plant is established by way of an expansion or is supported by the local authorities by way of provision of infrastructure facilities the cost of infrastructure would be low. In the case of projects located on undeveloped sites the cost of infrastructure would have been lower had the projects been required to bear only the cost of 'on site' facilities.

70. General experience in the country in recent years is that the cost of infrastructure financed as part of a project is usually about 10 per cent to 12 per cent of the project cost, and 20 per cent where captive power generation facilities are included. A standard size ammonia-urea plant with a capacity for the manufacture of 495,000 tonnes of urea per annum is estimated in the country to cost between $ 220 to $320 million inclusive of captive power generation facilities

depending upon the feedstock used. If the infrastructure facilities are provided by the State and Public Authorities on the lines suggested in the paper, that is, if a project is required to bear only the cost of 'on site' infrastructure facilities, then there would be a reduction in the cost of the project. Even a modest reduction of six per cent in the cost of a project by a reduction in the cost of infrastructure could result in a reduction in the cost of production of urea by $ 6 to $ 8 per tonne, which is not insignificant in the Country.

TABLE 4

IMPACT OF THE COST OF INFRASTRUCTURE ON THE COST OF NINE FERTILIZER PROJECTS

Project	Urea capacity per annum (000 MT)	Year of completion	Project cost (Mil.$)	Cost of infrastructure in project cost	%ge of infrastructure cost to project cost (%)	Impact of infrastructure cost on cost of production per tonne of urea ($/MT)
A	210	1971-72	27.11	0.94	3.5	1.00
B	330	1976-77	83.2	3.35	4.03	2.22
C	512	1975-76	81.75	5.61	6.86	2.18
D 1/	495	1979-80	205.3	18.29	8.9	7.39
E 2/	495	1979-80	209.5	17.49	8.3	7.06
F	330	1976-77	102.5	10.52	10.2	7.01
G	450	1969-70	65.7	6.59	10.0	2.93
H	280	1973-74	35.28	7.34	20.8	5.2
J	330	1973-74	112.6	21.29	18.9	12.90

NOTE : 1/ The cost of the various projects vary not only on account of the capacity and the year of completion, but also on account of feedstock.

2/ Projects A, C and J produce both complex fertilizers as well as urea. The cost of the projects and of infrastructure facilities in respect of these projects pertain only to the ammonia - urea manufacturing facilities.

COST OF VARIOUS ITEMS OF INFRASTRUCTURE FACILITIES IN THE NINE FERTILIZER PROJECTS

Cost in Million Dollars

Projects	LAND		WATER		POWER		ROADS		TOWNSHIP		RAILWAYS		PORT FACILITIES
	In hec.	Cost including dev. Charges	Annual Requirement in MnM	Capital cost	Annual requirement MW	Capital cost	Length in KM	Capital cost	No. of Units	Capital cost	Length in KM	Capital cost	Capital Cost
1	2	3	4	5	6	7	8	9	10	11	12	13	14
A	133.3	0.14	5.80	-	19.0	0.09	...	...	-	-	5.1	0.71	-
B	130.0	0.15	11.29	0.15	19.5	0.15	-	-	500	1.27	7.5	1.63	...
C	396.5	0.79	12.67	-	22.0	-	9	0.10	600	4.09	8.0	0.36	0.30
D	323.7	1.56	22.50	4.75	34.0	2.83	...	...	1664	6.47	17.0	2.68	...
E	323.7	1.06	22.50	4.48	34.0	2.91	...	...	1626	6.78	13.0	2.26	...
F	300.0	1.82	12.67	0.76	21.0	1.77	10	0.20	838	4.14	9.4	1.83	...
G	75.6	1.31	4.80	0.73	42.0	2.08	-	-	-	-	16.0	2.47	...
H	558.4	1.82	8.3	1.53	15.0	2.47	12	0.13	114	0.72	3.0	0.47	0.15
J	250.0	0.98	15.50	1.53	21.0	14.10	-	-	932	2.76	10.3	1.92	-

Note:- The variation in the requirement of power and water as between the projects is on account of the differences in the process employed.

C. INFRASTRUCTURE FOR THE DISTRIBUTION AND MARKETING FERTILIZERS

INTRODUCTION

71. Part B of this paper deals with the down-stream infrastructure needed for the distribution of fertilizers from the plant to the consumers, the farmers. An adequate infrastructure in the developing countries is one which enables the farmers to obtain fertilizers in adequate quantities and qualities at the right time, at the right price and with appropriate technical advice.

72. In describing such marketing infrastructure, other forms of infrastructure have to be taken into account. For example the infrastructure needed to market the farmer's produce must be regarded as equally important because it provides the farmer with compensation for the work done and can serve as a basis for credit.

73. Apart from the general infrastructure, the Government will be directly involved in the marketing of fertilizers through extension services, credit schemes, subsidies, laws, etc.

74. When the construction of a fertilizer project is planned in a developing country, that part of the infrastructure needed for distribution must be developed simultaneously if agriculture in the country is to profit from the project. As soon as the construction of a fertilizer plant has been decided upon, the build-up of the infrastructure should be started immediately in order to allow a constant flow of fertilizers to the farmer when production starts three to four years later.

75. This is the period when education and training of the personnel involved in the marketing of fertilizers is important; there will be a constant need for them to supply information on fertilizer use to the farmer.

76. The capital and operating cost of the infrastructure needed for distribution of fertilizers differs from country to country due to different geographic and climatic conditions and the state of development of the country's existing generalised infrastructures. Estimates cannot usefully be made; the

estimate must be specific to one country and take account of available transport equipment, storage buildings, etc. Standardization of equipment, transport and storage facilities can help to reduce costs, as can prefabrication of certain buildings. Estimates must also take account of local import duties and taxes. Therefore in this paper estimates of the cost of selected items of marketing infrastructure are made[1/]. These have been used to estimate the cost of establishing an infrastructure to distribute 300,000 tons of fertilizer in Part D.

77. Forward planning by the Government, the fertilizer industry and extension workers in the field is needed to develop the infrastructure needed for the distribution of fertilizers. Only close co-operation between all parties involved can create a good infrastructure.

1/ All cost estimates of the various infrastructure items are given in US$ at the exchange rates valid in early 1978. The measures are metric measures.

As local conditions may vary, prices and costs may deviate considerably from the indications given. All prices and figures given are indications only; they are meant as a guideline only. They have been based on data available from developing and developed countries.

Only the capital investment cost of the key items needed in all countries to build up an adequate infrastructure for the distribution of fertilizers are given. They are provided on a per item basis in order to assist the reader to make calculations related to a specific situation in a country.

THE ITEMS NEEDED FOR AN ADEQUATE INFRASTRUCTURE FOR THE DISTRIBUTION OF FERTILIZERS

78. The items needed in order to ensure regular supplies of fertilizers are:

A. Regular production of and/or import of fertilizers.

B. Storage facilities at the plant site and/or at the point of importation.

C. Transportation of fertilizers.

D. Storage facilities at the regional, district and local rural level.

E. Entrepreneurial and managerial skills.

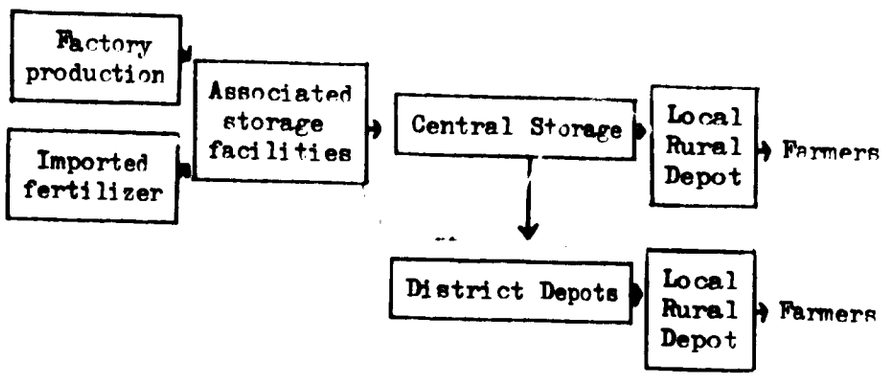
F. Credit facilities.

G. Agricultural Extension Services and modern agronomic practices.

H. Training courses on all the above-mentioned items.

I. Governmental planning, pricing, economic policies and laws.

79. Items A and B will be discussed on the basis of a very simple model which can be varied or multiplied according to the situation.



A. Regular production and/or importation of fertilizers

80. A precondition for the good functioning of the infrastructure is the availability of fertilizers in sufficient quantities and of the right type. Many of the developing countries have no fertilizer production of their own and are dependent on imports. Port facilities are often insufficient to handle large quantities at any one time and congestion problems prevent quick unloading of the incoming ships. Transportation inland, in many cases, takes up too much time(sometimes as much as two months) because of the vast distances and limited transportation possibilities. Therefore the inflow must be regular in order not to put too much stress on the infrastructure system. In those cases where there is local production, care should be taken that other types of fertilizers needed to supplement local production are imported and made available in good time.

B. Storage facilities at plantsite and/or port

81. Storage at the plant site should be of sufficient capacity to allow a regular production; it should not be a restricting factor at times when transportation meets great difficulties, for example in rainy seasons. The storage capacity at the factory should be at least two months production in bulk products plus some storage for bagged products. The capacity for bagged products depends to a great extent on the availability of further downstream storage facilities.

82. Storage facilities at the port need to be larger in order to regulate the irregular flow of incoming material. About 30 per cent of the yearly throughput of imported fertilizers for a particular port seems to be an acceptable figure in most conditions. If, however, speedy and regular downstream movement can be organized, the capacity might accordingly be reduced. For land-locked countries, which receive the material only by rail, the storage capacity might be much smaller, depending on the regularity of the incoming and outgoing traffic.

83. Importation of fertilizers should be made as far as possible in bulk. Savings of freight (10 per cent to 40 per cent) and handling charges (up to 50 per cent) can be substantial.

84. When climatic conditions permit, bagged material may be stored in the open, on a concrete platform and be covered with plastic sheets. However, an open roof is to be preferred.

85. Storage facilities should be built in such way that loading on railwagons, trucks or barges is possible without too much cost. As far as the bagging facilities are concerned it should be noted that they should be able to deliver bags of different weights such as bags of 50, 25 or 10 kilograms. This is to enable the small farmers to receive the quantity he wants without rebagging and also to facilitate transport in the rural areas.

86. An indoor storage for 20,000 metric tons of fertilizer can be estimated to cost US$1,500,000 plus equipment. This does not include land and quay, nor the unloading equipment for ships, nor the feeding installations for storage. The cost of a bagging unit, comprising the weighing and sewing with a capacity of 30 metric tons per hour, may be estimated to cost US$60,000. If seal sewing is wanted for polypropylene and polyethylene bags US$40,000 will have to be added. A complete unit, incorporating steel construction, bunkers, sieve, elevator, weighing, bagging and sewing may be estimated at US$90,000 (with seal sewing US$125,000). This represents the inside storage building costs. An open storage for up to 15,000 metric tons can be estimated at US$125,000.

C. Transportation

87. As distances to be covered are sometime enormous, the cost of transportation has a big influence on the price consumers pay for fertilizer. In some developing countries, such transport can more than double the price.

88. In most developing countries, as well as developed countries, waterways have proven to be the cheapest way of transporting fertilizers. It also provides the best opportunity for bulk transport. The capital investment for a 250 metric tons simple motor-driven open barge can be estimated at US$115,000. A 350 metric tons barge would cost US$155,000. To this has to be added the cost of covering and, if needed, living quarters.

89. Rail transport may prove to be the most economical form of transport for countries without waterways. However the capacity is, in many cases, limited and therefore slow due to the lack of sufficient railway tracks and wagons. This means of transportation is often overloaded. The great advantage is, as in the case for water transport, that without reloading fertilizers can be transported over long distances at moderate cost. All-year-round transportation is practically always possible.

90. No cost indications can be given in relation to the expenses involved in building railway tracks, nor of any extensions to it; such costs are completely dependent on local circumstances. As the tracks are all used for many other purposes as well as the transport of fertilizers, it is clear that the investment, maintenance etc. should be financed by the public exchequer. In cases, however, where sufficient public railwagons are not available to guarantee a regular flow of fertilizers to the central storage point, the fertilizer project should include provision to purchase a number of railwagons. The number depends on the distance, circulation and load permissible on the track. An 18 metric tons railwagon, with sliding doors for West European standard guage, will cost US$32,000/

91. Bulk transport by rail is also possible. For this purpose special wagons will have to be built, which, however, are not suitable for most type of freight that might be shipped on the return journey.

92. Where insufficient or no rail transport is available, trucks will have to be used for transportation to the central storage. Climatic conditions (rainy season) and road conditions, plus the distance to be covered, will determine the number of trucks needed.

93. A 10 metric tons truck for bagged material will cost US$35,000. Where the truck is equipped with a dumping platform for bulk transport, the investment will be US$40,000. In some flat countries, truck and trailer combinations on well-paved roads can be used. The cost of a 17 metric tons conbination is about US$47,000.

94. Transport from the central storage to the district depots will mainly be made by smaller trucks because of road conditions. A 6 metric ton truck will cost US$28,000. For transportation from the local rural depots to farmer, a small Jeep-type transportation vehicle is normally used (cost US$10,000), in those cases where the farmer himself is not able to pick up the fertilizers. High standardization of the truck fleet is essential to reduce maintenance costs.

95. All trucks can be used for return freight, but in calculating the number of trucks needed, careful consideration should be given to the time involved for this and the time available for fertilizer transport. The transport from the plant site/import storage must be regarded as the responsibility of the fertilizer project. If part or all of the transport required can be carried out by public or private enterprises, sufficient guarantee must be given that the transport will be executed in time. In many cases, it will be wise for the project to keep a few trucks in reserve in case of a break-down in the system.

96. Depending on the availability and cost of labor, palletized transport can be used to speed up the operation. In this case the cost of fork-lift trucks, US$ 25,000 for a 3 metric ton unit and pallets US$7 to 20 each, will have to be

added. An automatic palletizer may be used at a capital cost of US$250,000.

97. Since they also benefit many other users, the cost of roads and bridges, as well as the maintenance, improvement and extensions are clearly the responsibility of the public exchequer.

D. Storage facilities at regional, district and local level

98. As the territory to be covered by a fertilizer project generally is very large, central storages will have to be built at strategic points, as near as possible to the consuming areas. This can be at a river or lake-side, along railways or at the rail-end, at crossings of main roads, etc. Investment costs will be, in principle, the same as indicated under section A.2. If bulk material is received at waterfront a grabcrane will have to be added to the investment. The cost of a 40 metric tons/hour mobile grabcrane will be US$80,000; for an 80 metric tons/hour grabcrane the cost is US$150,000.

99. If material is received in bulk at the central storages and the throughput is sufficient, a bulk-blending installation could be of help to provide the farmer with the type of fertilizers that he wants. Investment cost for a simple 10 to 15 metric tons/hour blending installation only, including weighing equipment and steel construction, will amount to US$35,000. Although product-handling must be kept to a minimum, to keep the cost down and prevent losses, an intermediate storage between the central storage and local depot may be needed. This mainly depends on the distance to be covered. These intermediate storage-district depots should in general, not be more than 100 km away from the central storage. An indoor district depot of 500 metric tons will cost US$50,000 and for 250 metric tons about US$30,000. An open storage of 500 metric tons will cost US$6,000 and of 250 metric tons US$5,000.

100. As the farmer needs to be within easy reach of the fertilizers, local depots are needed. They can be of a simple nature and small capacity and, depending on the demand in the area, of capacity 20 metric tons to 100 metric tons. An indoor depot of 100 metric tons capacity will cost US$6,000 to US$8,000, with 50 metric tons capacity about 60% and with 20 metric tons 25% of the above mentioned investment. For open storage costs about 50 per cent less and for open-roof constructions approximately 30 per cent to 40 per cent less can be reckoned.

101. In villages with very low consumption, the problem of storage may be overcome by trucks from the district or local depot that deliver the goods at a pre-announced day, to be picked up by the farmer that same day.

102. As normally a large number of district depots and especially local depots are needed, standardization and prefabrication of storage facilities might bring some savings in their cost.

103. The local depots (which should be within the 10 kilometers limit to the farmer and often next to a storage for other farm inputs or farm products) will have to be completely separate in order to prevent contamination. At all storage places, offices, washrooms and sometimes a canteen will be needed. As for the central storage, these provisions will cost US$4,000; at the district depot the cost will be US$2,500. At the local depots, such facilities without canteen can cost about US$2,000 of which, however, only a part of the cost should be attributed to the fertilizer activities,depending on local conditions.

E. Entrepreneurial and managerial skills

104. Well developed human skills are needed at all stages of the infrastructure. What tasks will have to be performed?

- Unloading and loading of the material.
- Weighing and bagging, eventual blending.

- Maintenance of equipment and building.
- Control on quality and weight.
- Control on the economics of each operation.
- Control on environmental measures.
- Planning of outgoing and incoming traffic.
- Book-keeping and administration.
- Short-term and forward planning and ordering.
- Overall surveillance and management.

105. Marketing and often credit activities will, in many cases, be part of the task to perform, when not performed by other institutions or organizations. Furthermore a great degree of skill for improvization may be needed to prevent constraints within the system.

106. The task at the central storage and at the factory and importation point will differ from that of the district and local depots. Especially in the last two cases, which are closer to the farmer, other tasks will have to be performed. The responsible person for the local depot must be able to advise the farmer on the type and quantities of fertilizers that he should use on his crop. He must be aware of the credit possibilities and additionally be able to assist the farmer to acquire this. He will not only take direct orders and orders for the next season but will also have to make estimates for total quantities, divided by types, for the next season. He can be regarded as one of the key figures of the whole system because his indications will be the basis for calculations made by the district and finally by the central storages to estimate the overall needs of the country. Furthermore, the function of the local depots man-in-charge is not only restricted to fertilizers; he will also deal in other farm inputs and also market the farm produce. It is logical to assume that while the district and central storages are located at strategic points with good connections and transport availability as well (return freight), the farmer's produce will follow the same route, in the reverse direction.

107. An estimated cost for operating a storage or depot cannot be given. Not only do salaries and wages differ between the different countries, but also the throughput and level of mechanization of the facilities will vary. The permanent staff should be kept at a low level, while in peak times, labor on a

part-time basis can be hired.

108. The manner in which storages and depots are run, varies greatly in different developing countries. It can be performed by farmers' associations or co-operations, administrations of communes, village heads, private traders, millers, sugar mills, agro-service centers, credit cooperatives, missions of religious orders etc. Some of them may be responsible for the whole distribution e.g. marketing and processing enterprises - private or public owned -; others will only take care of part of the distribution. Farmers' cooperatives or organizations or private enterprise might take care of the district and local depots and all the activities belonging to it. All kinds of mixed forms of distribution system also exist. Care should be taken that all steps in the distribution channel are self-supporting. The margins added to the price should be set at such a level that after deduction of costs and risks, the net profit is of sufficient level to be an incentive to continue and extend the activities and in particular that of marketing fertilizers.

F. Credit facilities

109. Practically all farmers, in developing and developed countries, need credit. It can be supplied by governmental or semigovernmental institutions, credit or commercial banks, farmers' organizations, private money-lenders and so on. Whoever the credit giver may be, the procedure should be simple and not time-consuming.

110. In quite a number of countries, the procedure is too cumbersome and thus prevents the farmer from ordering his fertilizers on time because he is not sure he will get the credit for it. The small farmer especially, will not be able to offer much collateral (credit is often given against the next crop). Interest in many countries runs at a rate of 12 per cent per annum with repayment on delivery or sale of the crop. A margin for bad debts of 5 to 10 per cent is often

added, thus bringing the effective rate to as much as 13.2 per cent per annum. Other countries, through governmental or semi-governmental agencies include the bad debt risk in their tarrifs or give a low interest rate as a kind of subsidy. Some credit cooperatives even work on the principle that their members are only charged a fee for administrative costs and no interest. The condition attached is that they sell their produce to the cooperative which then acts as a marketing organization, and repayment is made at that time. Local dealers may also give credit; their interest rates are normally higher and their capital restricted; but they generally act faster. The acquaintance of the farmer to the local man in charge, the local marketing man and the extension workers can, in many cases, be of help in judging the credit-worthiness of the farmer in question.

111. Revolving funds which make loans to farmers as practised in many countries, can be of great help to build up the credit-worthiness of the farmer.

C. Agricultural Extension Services and modern agronomic practices

112. The Agricultural Extension Service has not only the task to advise the farmer on the types of drop he should cultivate on his soil but also what type of fertilizer and how much to use, bearing in mind the crop value/fertilizer cost ratio. Moreover it should teach modern agronomic practices.

113. As many farmers in the developing countries are illiterate, most of the information will have to be given verbally and by demonstrations. Field days and field demonstrations, together with information and discussion meetings at village level, will be the best method. These demonstrations and meetings should be preferably held together with the fertilizer marketing force in order to co-ordinate the information and avoid duplication. This type of approach has in the many FAO fertilizer projects proven to be very

useful. (It goes without saying that simple and clear marketing in different colors on the bags will facilitate matters).

114. Experiments not only carried out at the research stations but also in the field will be of help, especially to the more educated farmer.

115. As all these activities not only relate to fertilizers but also to all other farm inputs, irrigation and so on, it is clear that the costs involved will have to be borne by the public exchequer.

H. Training Courses

116. It is obvious that for the personnel involved in the already described activities, training is necessary. Refresher courses will also have to be held, regurlarly. Training of key personnel in other countries with an already well-established infrastructure, is very advisable.

117. As far as handling, distribution and marketing of fertilizers is concerned, this should be for the account of the fertilizer producer or supplier. The other activities should, in principle, be for the account of the public exchequer. This does not exclude that the fertilizer project and farmers' cooperatives are participating in the training to a certain extent and consequently could bear part of the cost.

I. Governmental planning, pricing, economic policies and laws

118. Governmental planning will very seldom only be restricted to infrastructure for the distribution of fertilizers. Practically all the measures taken will be of benefit to the whole composite infrastructure, building the national economy or a larger part of it. Planning and carrying out of rail and road constructions and their improvement, is such an example. Building up an Agricultural Extension Service will be of benefit to the whole agricultural sector.

119. However, in some instances the measure will be directly related to fertilizers. Building a fertilizer plant or giving permission for it to be built is a typical example. For this the government must be able to forecast accurately the future

consumption and the feasibility of the project. Laws and regulations for safety and environment must be made. Financial ways and means have to be sought for, not only for financing the plant itself but also for the infrastructure going with it.

120. Another important task for the government is the timely ordering (or granting of permission to do so) of the imported fertilizers that the country needs. For this purpose it needs staff to collect the necessary information. This staff can, to a great extent, get this information from the extension services and from the fertilizer and marketing trades. As fertilizer consumption not only depends on the prices of these but also on the price level for different crops, inter-governmental discussions are highly necessary. (Price level here, means either firmly fixed or with a certain high and low level or the expected market rate).

121. The pricing and economic policy will influence the use of fertilizers and food production to a very great extent. The import duty on fertilizers, raw material, equipment, transport vehicles as well as taxes - direct or indirect - will influence the price. Subsidies and cheap credit facilities can bring the price of fertilizers down to a remunerative level in relation to farm produce.

122. The laws concerning fertilizers should give the farmer a guarantee with regard to the quality - nutrient content - and weight. This implies that the government should set up institutions to control this.

123. Other laws might give regulations and rules concerning the storage and office buildings in order to safeguard the safety, health, environment and pollution aspects.

II. DEMARCATION OF RESPONSIBILITIES FOR ESTABLISHING INFRASTRUCTURE FOR THE DISTRIBUTION OF FERTILIZERS

124. The consultation meeting may wish to note that a clear demarcation of responsibilities cannot be given due to the fact that in practically all countries some form of infrastructure already exists and whatever concerns fertilizer distribution and marketing tends to be fitted within the existing system. However, in the case where nothing exists and a complete infrastructure has to be established, the following demarcation is suggested for two stages of the project.

First Stage

125. In the first stage, the fertilizer project should be responsible for the capital cost, working capital required and depreciation maintenance and renewal of the following facilities:

- All investments made at the plant site.
- Facilities to handle fertilizer at the port of importation.
- Central Storage and District Depots (including, in new areas, housing for personnel).

126. Transportation vehicles between the different storage points and those needed for business reasons (marketing etc.) are equally the responsibility of the project, as well as salaries, wages and social provisions for the people involved. Fertilizers should be placed in the above-mentioned storage places on a consignment basis.

127. The State and other Public Authorities should be responsible for :

- all public works (railways, roads, etc.) maintenance, renewal and extension.
- provision in the public sector, hospitals, transport, etc.

- financing of credit and subsidies.
- forward planning and ordering.
- extension service and laws and their enforcement.
- all salaries, wages and social provisions for the people involved.

128. Following the reasoning that the local rural community should form the start be directly involved, it is suggested that it takes responsibility for that part of the infrastructure, the storage, handling, marketing and transport plus the complete cost of the personnel involved. This can be done by different types of organizations or people. In cases where the local population cannot bear the costs, assistance by the Government or the fertilizer project should be given. This, however, with the intention that all facilities should be owned and run as soon as possible by the local people.

Second Stage

129. As the fertilizer infrastructure develops, the district depots and may be even some central depots can be taken over by farmer organizations or coops, or others. The same goes for transportation between those points. A rebate on early out-of-season delivery may be a stimulant. This system has, when the rebate is sufficient, proven to be of great influence on the regular flow and timely availability of fertilizers in the developed countries.

130. It seems to be preferable that some of the central depots remain within the responsibility of the fertilizer project in order to safeguard the necessary storage needed for regular production or imports. The responsibility of the State and other Public Authorities remains the same as in the first stage. The responsibility of the farmer (in his different organizations), that of private enterprise or public enterprise in other forms will increase. Consequently part of the investment originally made or performed by the fertilizer project will be recovered by the project.

III. ASSISTANCE FROM OUTSIDE IN ESTABLISHING INFRASTRUCTURE FOR THE DISTRIBUTION OF FERTILIZERS

131. The Consultation Meeting may wish to note that assistance from outside can be given in many forms to developing countries that organize the infrastructure needed to distribute fertilizers. This can be given in the form of providing finance, technical know-how and skilled manpower. Since such assistance is an important input to raising agricultural output, it should be provided as a grant or on soft terms wherever possible.

132. In the early stages, assistance at the local rural level (storage, transport, credit, revolving funds, etc.) will be particularly important to the creation of a good fertilizer infrastructure. It is therefore suggested that when countries supply fertilizers as aid, they should be accompanied at the same time by this type of assistance at the local rural level. For example, funds raised by selling the fertilizer given to the country can be used to finance such local efforts.

133. Some countries with their own fertilizer production lack a sufficient infrastructure to distribute fertilizers to the home market. It must be regarded as a duty of both the fertilizer project, the Government and other public authorities to take urgent steps to improve this situation. Such initiatives can then be supported by the international assistance as and when required and requested by the Government.

D. ILLUSTRATIVE CASE STUDY OF THE TOTAL INVESTMENT REQUIRED TO ESTABLISH THE INFRASTRUCTURE TO DISTRIBUTE AND MARKET 300,000 TONS (MATERIAL) OF FERTILIZERS

I. Assumptions made for the illustrative case study

134. In this case study, detailed estimates of the total investment required to establish a complete distribution infrastructure are made based on the following assumptions:

(a) Consumption of 300,000 tons of fertilizer material containing N, P and K nutrients per year and a regular all year flow of the fertilizers from port/factory to the local storages.

(b) One main storage depot at a port or fertilizer plant with a storage capacity of 50,000 tons with a throughput of six times per annum handling a regular inflow of 300,000 tons per annum.

(c) Three central storages of which one is situated 100 km from the main storage and only served by truck and two located on railtracks, one at a distance of 250 km and one at 350 km from the main storage. All three have a storage capacity of 20,000 tons and a throughput of 100,000 tons per year.

(d) Half of the yearly consumption is handled through district depots, each with a storage capacity of 1000 tons and a throughput of five times per year. The district depots have each 500 tons openroof storage. Total number needed 30.

(e) Half of the yearly consumption is directly transported from the central storage to the local depots.

(f) A total of 3000 local depots, each with a capacity of 20 tons (indoor) and an annual throughput of five times, that is 100 tons per year. Only 25 per cent of the investment for offices and transport vehicles at this level is needed for fertilizers since it may be assumed that these facilities will also be used for many other purposes.

(g) All fertilizers are received in bulk at the main storage and there bagged and palletized[1/]. Transport to central storage and district depot is done on pallets. The transport to the local depot is not palletized. Where needed all truck platforms have been adapted to pallet measurements.

1/ No provision is made for the investment required as these facilities would normally be part of the plant.

(h) The cost of Ten Agricultural Extension Centres is incorporated in the total investment cost.

(i) The estimate of working capital required is based on an average found from data available from developed and developing countries.

135. As local conditions in the various developing countries may vary very much, for example road conditions and the speed of rail transport, considerable differences in investment costs may result.

II. Total investment costs and comparison with findings of other studies

136. The total fixed investment required to establish an infrastructure to distribute 300,000 tons of fertilizer per annum is US$ 45.8 million or US$ 152 per ton. Working capital requirements would add US$ 77 to US$ 120 per ton.

137. The outcome of this hypothetical case study differ only a little from the studies made by W.F. Sheldrick for the World Bank in January 1976 1/. In these studies, based on seven cases covering different throughput rates and type of operations, it was found that the average investment to distribute and market fertilizers ranged from $ 180 to $ 160 per ton of annual throughput; the operating cost was an average of $ 50 per ton. This World Bank study came to the conclusion that the additional investment in the infrastructure for distribution and marketing fertilizers should match the cost of investment in the production of the fertilizers.

138. A study made by the Agency for International Development, Washington D.C. by F N Paker in 1968 2/, based on a number of cases, came to practically the same conclusions.

139. As a general conclusion it can be said that for every dollar invested in fertilizer production, investment of at least one dollar is needed to establish the supporting infrastructure for distribution.

1/ The risk of the World Bank in helping to meet the fertilizer requirements of developing countries. January 1976.

2/ The functions and cost of a fertilizer marketing service.

III. Detailed calculations of investment costs

Investments

Port/factory main storage

capacity : 50,000 tons throughput 300,000 tons/year	$ 3,500,000	
office and other buildings	500,000	
land a $10 per m^2	600,000	
input equipment	PM	
payloaders (6) plus forktrucks (6)	390,000	
bagging 60 t/h 16 h/d 320 d/y	540,000	
pallets+div.equipment+spareparts	860,000	
10t trucks incl. reserve à $37,000 total 33 10 t/d loaded 100 km/d 320d/y = 100,000 t/y	1,221,000	
110 rail wagons incl.reserve à $32,000 average 1850 t/y 360 d/y	3,520,000	
		$ 11,131,000

Central storage

capacity: 20,000 tons throughput 100,000 t/y	1,500,000	
office	4,000	
land à $ 5 per m^2	125,000	
3 forktrucks à $ 25,000	75,000	
55 trucks 6t à $ 30,000 (incl.reserve) 6 t/d loaded 100 km/d 320 d/y	1,650,000	
equipment + spare parts	50,000	
Total per central depot	3,404,000	
For three central depots needed		$ 10,212,000

District depot

capacity 1,000 t throughput 5,000 t/y 500 indoor + 500 t open roof + office	75,000	
land	PM	
1 truck 6t + 1 truck 1,5t average transport 15.6 t/d 320 d/y	38,000	
equipment + spare parts	10,000	
Total per district depot	123,000	
For thirty district depots		$ 3,690,000

Local depots		
capacity 20t throughput 100 t/y	$ 2,000	
land	PM	
share office investment	500	
share transport vehicle investment	2,500	
equipment + spare parts	500	
Total cost per local depot	5,500	
For 3,000 local depots		$ 16,500,000
Agricultural Extension Centres		
Building	400,000	
transport vehicles: 2 Landrovers + 10 motor driven bicycles + 50 bicycles	12,000	
field equipment + spare stock	12,000	
Total cost per Agricultural Extention Centres	424,000	
For Ten Extension Centres		$ 4,240,000
TOTAL INVESTMENT FOR 300,000 t/y		$ 45,773,000

INVESTMENT REQUIRED PER TON OF FERTILIZER DISTRIBUTED

Total physical investment per ton throughput	$ 153
Working capital required per ton throughput	$ 77-120
Total Investment required for Distribution and Marketing of fertilizers per ton throughput	$230-273

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