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DEVELOPMENT OF THE CHEMICAL FERTILIZER INDUSTRY

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UNITED REPUBLIC OF TANZANIA

Mission report

24-30 October 1976

by

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United Nations Industrial Development Organization

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Explanatory notes

References to dollars ($) are to United States dollars.

The monetary unit in the United Republic of Tanzania is the Tanzanian shilling (TSh). During the period covered by this report, the value of the TSh in relation to the United States dollar was TSh 8.40 = $US 1.

A slash between dates (e.g. 1970/71) indicates a fiscal year.

Use of a hyphen between dates (e.g. 1960-1965) indicates the full period involved, including beginning and end years.

A full stop (.) is used to indicate decimals.

A comma (,) is used to distinguish thousands and millions.

References to "tons" are to metric tons.

The following abbreviations of organizations are used in this report:

FAO	Food and Agriculture Organization of the United Nations
INDCENTRE	Industrial Studies and Development Centre
NAFCO	National Farmers' Co-operative
NDC	National Development Corporation
NIDC	National Industrial Development Company of India
STAMINCO	States Mining Corporation
TFC	Tanzania Fertilizer Company
TIB	Tanzania Investment Bank
TPDC	Tanzania Petroleum Development Corporation
TRDB	Tanzanian Rural Development Bank

The following technical abbreviations are used in this report:

AS	ammonium sulphate
ASN	ammonium sulphate nitrate
CAN	calcium ammonium nitrate
DAP	diammonium phosphate
NPK	nitrogen-phosphorus-potassium
SSP	single superphosphate
TSP	triple superphosphate
tons/day	(metric) tons per day

ABSTRACT

At the request of the Resident Representative of the United Nations Development Programme (UNDP) there, a short exploratory mission to the United Republic of Tanzania was undertaken in October 1976 to investigate problems arising from the plans of the Government to develop the chemical fertilizer industry. The mission was also expected to identify viable projects for technical assistance to the Government in the field of the production of chemicals.

Relevant government institutions were visited and discussions were held on prospects for exploiting the newly discovered natural gas resources and developing fertilizer and chemical industries based on them. Extensive information was obtained during visits to the Tanzania Petroleum Development Corporation (TPDC), the States Mining Corporation (STAMINCO), the Industrial Studies and Development Centre (INDCENTRE), the World Bank and the Tanzania Development Bank (TIB). Productive discussions were conducted with the Country Representative of the Food and Agriculture Organization of the United Nations (FAO), the General Manager of the Tanzania Fertilizer Company (TFC) at its Tanga factory, and with the Director of the Production Division of the National Development Corporation (NDC). UNIDO experts attached to TPDC provided basic information for the assessment of the present situation and future prospects of the petroleum and natural gas exploration programme and the project for expanding the Tiper refinery at Dar-es-Salaam.

A concluding meeting was held with the Minister of Industries, who expressed his satisfaction with the assistance provided so far by UNIDO experts and welcomed the opportunity for continued co-operation with UNIDO in establishing a long-range strategy for the development of the chemical industry of Tanzania in general and of the fertilizer industry in particular.

After it had completed its working programme at Dar-es-Salaam, the mission was debriefed by the Resident Representative of UNDP, who expressed interest in increasing the involvement of UNIDO in the development programmes undertaken by the Government. While the UNDP country programme for 1977 now appears to be overcommitted, the Resident Representative was of the opinion that the second-cycle Indicative Planning Figures (IPF) may reflect the need for intensified operations of UNIDO in the chemical sector if the Government is to stress development projects in the chemical and fertilizer sectors as priority items for immediate implementation.

The mission submitted a detailed plan of action for the guidance of all parties concerned. The persons met by the expert at Dar-es-Salaam during the mission are listed in annex I.

CONTENTS

Annexes

CONCLUSIONS AND RECOMMENDATIONS

The establishment of a nitrogen fertilizer factory based on the natural gas field which was discovered recently in Tanzania can be recommended. However, this generally viable project has some limitations that must be considered when implementing it.

The domestic market for nitrogen fertilizers other than ammonium sulphate (AS) is at present too small to justify the establishment of a small-scale ammonia/urea plant of economic size before 1980.

Although the domestic consumption of fertilizers is bound to increase steadily, it seems unlikely that, within the next ten years, consumption will approach a level that would justify the establishment of a medium-sized ammonia plant of at least 600 tons/day capacity.

Attempts should be made to arrive at solutions that would stress either the country's need to save foreign currency through substituting imports of ammonia and nitrogen fertilizers (short-term objectives) or give preference to establishing a large-scale, competitive fertilizer project that would make extensive use of indigenous natural gas and be able to export to neighbouring countries (long-term objectives).

A number of detailed investigations and studies are needed to provide a reasonably complete set of technical, techno-economic and socio-economic alternative assessments that would make it possible to identify the long-range fertilizer development programme that would be most suitable from the national point of view.

There are many interrelated factors that must be considered before a firm decision on the scope and timing of the project can be made. They are the following:

Development of the natural gas field

Timely construction of the natural gas pipeline

Implementation of the Tiper Refinery Expansion Project

Installation of the natural gas processing plants at the refinery

Projections of the fertilizer demand - supply balances of the country and subregion

Location of the fertilizer complex

Development of marketing and agricultural infrastructures

Development of the technical infrastructure for the fertilizer complex

The Government should consider a subregional scheme of fertilizer production and distribution among neighbouring countries. Tanzania might thus be given the opportunity to supply the East African subregion with urea at competitive prices, provided that the projected fertilizer plant will be of optimum size and suitably located.

Immediate decisions should be taken by the Government and agricultural organizations to develop a market for urea and/or other nitrogenous fertilizers, excluding ammonium sulphate (AS). Owing to the fact that the application of fertilizer is still at an early stage in Tanzania, several years of consistent agricultural extension work will be necessary to ensure that there will be a market for the large local supplies that are anticipated.

After start-up of the natural gas-based ammonia/urea plant the competitivness of AS production at the Tanga plant of the Tanzania Fertilizer Company (TFC), will be doubtful. Any fertilizer development plans should take account of their effect on the future of existing capacities and the feasibility of continuing operation of the AS plants which, on the other hand, will by then be supplied with relatively cheap locally manufactured ammonia.

In connection with the favourable prospects of development projects based on utilization of indigenous natural gas resources (and possibly crude oil), the Government should attempt to identify a consistent strategy for developing the chemical industries in general and the fertilizer/petrochemical industries in particular. The development programme should cover the period from 1980 to 2000. Subregional co-operation should be emphasized, because it appears unlikely that the world market situation will be sufficiently favourable to permit the establishment of a large-scale export-oriented chemical industry in Tanzania after 1980, except perhaps in the context of multilateral arrangements for supply and specialization within the subregion.

There are many organizations in Tanzania that should be developed and strengthened to carry out the studies and investigations recommended here. Superficial and hence misleading feasibility studies should be avoided. However, economic appraisals of projects should be made under the strict condition that data on capital investment requirements and financing arrangements would be available from competent and reliable sources. International competitive bidding should be the rule for collecting data on plant and equipment costs.

Design and engineering capacities should be developed in the country in connection with pending projects that entail considerable investment in the chemical industry. The favourable raw materials situation and the growing demand for chemicals provide ample justification for developing import-substituting industries so as to attain a reasonable degree of self-sufficiency in the manufacturing sector. The development of engineering services should therefore be undertaken in parallel with the implementation of investment projects.

A pragmatic approach should be taken to project development and implementation as outlined in the Plan of Action later in this report (chapter VII). Project management teams should be appointed as soon as justifiable by the work programme to be conducted. Foreign assistance should be requested and organized in a consistent way to support local staff and to achieve best results in transfer of experience.

The Government of Tanzania should be encouraged to request from UNIDO technical assistance and unbiased advice on the various subjects considered in this report, particularly, those listed in the Plan of Action. In this respect, the Government should be advised that emphasis should be laid on self-reliance in the preparation of investment projects since there have been many cases in which developing countries have had bad experiences after having committed the assessment of feasibility, project preparation, contracting and implementation of projects to a single contractor. The Government should be made aware of the inherent risk of such a procedure, especially since there are indications that such practices are now given preference in Tanzania.

UNDP should consider the development of local capabilities to organize investment projects as a matter of high priority. For this reason this report recommends providing consultancy services and assistance through UNDP funding to support efforts made by Tanzanian organizations. There is a need to strengthen engineering and design capacities, and in this connection this report recommends that a suitable large-scale project be included in the second UNDP country programme.

I. INTRODUCTION AND BACKGROUND

Natural gas was discovered recently in the United Republic of Tanzania and was evaluated favourably for utilization as feedstock for improving the operations and output of the existing oil refinery and for the manufacture of nitrogenous fertilizers. A team of UNIDO experts was assigned to assist the Tanzania Petroleum Development Corporation (TPDC) in planning the expansion of the refinery and has worked out concepts for processing natural gas for various purposes. Under the guidance of a UNIDO Economic Adviser, a junior professional of TPDC made a pre-feasibility study on establishment of a ammonia/urea plant at the Tiper Refinery at Dar-es-Salaam. This study was concluded in November 1975. It provides general information on manufacturing processes and includes an assessment of the economics of the project. Data on the present and estimated future demand and consumption of fertilizer were compiled from various sources, but primarily from an in-depth investigation of trends in agricultural development that was conducted in 1974 by the National Industrial Development Company of India (NIDC) for the National Development Corporation (NDC) of Tanzania. NIDC carried out a comprehensive strategy cum feasibility study on a naphtha-based nitrogen fertilizer factory.

Both the TPDC prefeasibility report (Rajvade and Sheth of 1975) and the NIDC study of 1974 (annex II) suggest that there is full justification for establishing an ammonia/urea plant to satisfy Tanzania's growing demand for nitrogenous fertilizers. The NIDC report, which was concluded in 1974 before domestic sources of natural gas had been found, recommended the use of naphtha as feedstock for production of ammonia. Under presently prevailing conditions, however, there is generally no doubt about the economic disadvantages of naphtha-based ammonia plants as compared with those using natural gas. The validity of the technical part of the NIDC report (Volume II) therefore appears disputable (annex II). Any estimates of capital investment and operating costs made more than a very few years ago have become outdated owing to major changes in naphtha and crude oil prices on the world market and to the world-wide inflationary increase of capital costs of chemical plants experienced since 1974.

The pre-feasibility study made by TPDC took account of the recently discovered natural gas. Because of the lack of industrial experience of its author and the non-availability of solid data on equipment prices and construction costs, the study could not be recommended by UNIDO as a basis on which to advise the

Government on steps to be taken to initiate implementation of the pertinent investment project. Furthermore, it was found that, at that time, no long-range development strategy had been established by the Government for the chemical industry of Tanzania. Although a number of relevant studies had been conducted by various organizations, there were virtually no applicable conclusions that might facilitate the inception of a broadly based investment programme for the development of the fertilizer and petrochemical industries. With this background in mind, the mission made an attempt to assess the viability of the fertilizer project from various points of view, without, however, going into technical details that may now be of minor importance.

II. NATURAL GAS RESOURCES AND EXPANSION OF THE TIPER REFINERY

General assessment

Reserves of natural gas were discovered in 1974 about 6 km offshore from Songo Songo Island. Although at that time the field was declared to be non-commercial, exploration was continued. There was a wide disparity between estimates on the magnitude of reserves made by various consultants. However, probable reserves are now reliably estimated at 30 billion m^3; and the Government has therefore approved further off-shore drilling programmes, placing much hope in a simultaneous discovery of oil.

The two UNIDO experts attached to TPDC are assisting the Government in exploring for hydrocarbons and drawing up a development programme for the use of natural gas as well as for expansion of the Tiper refinery at Dar-es-Salaam. Excellent results have been achieved so far, and recommendations made by the team provide an appropriate background for further considerations of the industrial use of natural gas. Their valuable interim and final reports contain all essential data required for continuation of drilling programmes and for the decision-making bodies of the Government to whom the respective recommendations were addressed. More specifically, two unpublished reports should be mentioned (Progress report, 1 December 1975 to 31 May 1976, and Final report, 20 September 1976). These reports provide a comprehensive picture of work done so far and of the favourable expectations regarding future hydrocarbon feed-stock supplies from domestic resources. Pursuant to the consultant's advice, a third test well is being drilled on the island. According to the latest schedule, it was to be completed by March 1977. Unfortunately, there was a blow-out at the second well when a depth of almost 1,000 metres had been reached. However, even this well gave evidence of the presence of associated gas under high pressure on Songo Songo Island and in adjacent waters.

Implementation of investment programmes

In summary, the findings and recommendations made by the UNIDO team should highly be appreciated and should be considered seriously by the Government for its immediate investment programmes. The indications are of such nature that there seems to be almost no inherent risk in undertaking investment to implement at least two basic projects of the proposed development programme emerging from the discovery of the natural gas field.. These are:

Construction of the pipeline from the gas field to the refinery and cement factory at Dar-es-Salaam

Construction of the hydrogen unit and the hydrocracking complex at the refinery

As the hydrogen unit is assumed to be the main consumer of the natural gas, there appears to be sound justification to proceed with the relevant projects as soon as the results of drilling at the third site confirm the correctness of previous estimates. In this connection, attention is drawn to the final (unpublished) report of the UNIDO experts, dated 20 September 1976. In paragraphs 4 and 5, which deal with the exploitation of natural gas and the expansion of the Tiper refinery, it was mentioned that the Government has accepted the expansion scheme in principle and it now awaits preparation of a detailed feasibility cum project report by competent consultants for presentation to financing institutions so as to secure the requisite loans. No decisions have yet been made towards the implementation of the programme described above, comprising the ammonia plant, hydrocracker complex, sulphur recovery and the supply of gas as fuel to the existing cement factory. For reasons that are presented later in this report, the ammonia project should, for the time being, be deleted from the refinery expansion project.

It seems uncertain whether TIB or another financing institution will be involved in the project. Reportedly, however, TIB has selected or appointed an engineering company as a consulting firm to carry out a feasibility study on a small-scale ammonia/urea project. As concerns the pre-project design and appraisal of economic feasibility of all the natural gas-based projects mentioned above, there are no local organizations available to carry out this work. For this reason the Government should consider requesting technical assistance from UNIDO. A technical adviser should be attached to TPDC and co-operate closely with the Government, the financing institution and the engineering company. He should also participate in the selection of the engineering company. In general, the UNIDO consultant would function as project co-ordinator and adviser to the Government on general and technical aspects of project organization. Standard international procedures should be adopted for selection of engineering companies and contracting of engineering services. This concerns competitive bidding, unbiased evaluation of tenders and the formulation of mutually advantageous contracts. For this purpose the independent consultant should be appointed by the Government in due course, but in advance of any financial committments with respect to project implementation.

At present, advantage should be taken of the presence of the UNIDO economic adviser to TPDC whose contract was recently extended to 1 November 1977 at the request of the Government. He should be invited to prepare, in co-operation with the Ministry of Industry, all relevant requests for further technical assistance to be provided by UNIDO, including:

Technical consultancy services as delineated above (project co-ordination)

Subcontracting project management through UNIDO

Technical expertise on particular items of interest to TPDC or the Ministry. (These functions are thought of as supplementary to the work of the engineering company, particularly as regards off-site facilities and the development of infrastructure.)

Assignment of UNIDO technical experts to carry out specific tasks during implementation of the project at the refinery as:

Supervision of engineering and design

Supervision of construction, erection and civil works

Start-up management of the individual plants

Training programmes relating to the new plants and the operation of the pipeline.

As already stated, the conclusions drawn by the UNIDO economic adviser concerning expansion of the refinery indicate that the proposal has been based on economically viable concepts. Technical details of the projects should now be worked out by competent engineering companies, while the subsequent appraisal of the financial problems involved might well be conducted by consultants to be appointed by the financing institutions. Not infrequently, feasibility studies conducted by technical experts are unacceptable to financing institutions, so the studies are repeated by the banks, which apply their own methods of calculation. It may be noted that no market or raw-materials constraints are expected to be encountered in connection with the gas exploitation and refinery expansion projects. There is thus no need for conventional feasibility studies. If such studies are made before collecting tenders and working out a fairly precise construction cost estimate based on pre-project design of plants, the conclusions often do not appear very useful in practice. The mission therefore suggests that pre-project (or preliminary) design be initiated without delay. With reference to the list of projects proposed by the economic adviser, however, the construction of the pipeline should be included and the ammonia/urea complex should be deferred for the time being. The list should also cover all required off-site expansion projects which, however, will have to be co-ordinated with the definite general expansion programme of the Tiper refinery in connection with which some preliminary design work appears to be advisable.

Organization of the development programme

The mission suggests to adopt the following programme of preparatory work to be conducted by TPDC:

(1) Appointment of staff to be responsible for implementation of the refinery expansion projects

(2) Government decision to give the projects appropriate priority

(3) Assignment of a general technical consultant to TPDC

(4) Selection of an engineering company to carry out preliminary design

(5) Contracting engineering services for preparatory work and techno-economic pre-investment studies

(6) Formulation of tender specifications and decision on the type of contract for construction of the plants

(7) Selection of contractors and suppliers to be invited for tendering

(8) Evaluation of tenders

(9) Final financial appraisal of the project based on reliable cost estimates and offers

Item 5 above should cover the preliminary planning of the plant location, off-site facilities and assessment of infrastructural requirements in order to provide the required input data for item 9, particularly data on the capital investment needed in addition to expenditures covered by the various tenders. Furthermore, construction of the pipeline should be included in the programme from the very beginning to facilitate co-ordination of the projects.

Development of the natural gas field

Development of the exploitation of the gas field should be undertaken as a separate exercise, since the technical problems here are different from those of the construction of plants. The work should go forward immediately after the successful drilling of the third well. Also, in this case it appears advisable for the Government to take advantage of continued services of UNIDO technical experts. Owing to the fact that exploitation of gas and, it is to be hoped, of oil, would be undertaken for the first time in Tanzania, TPDC would need extensive foreign expertise to implement the project correctly.

III. ESTABLISHMENT OF THE NITROGEN FERTILIZER FACTORY

General assessment

With the discovery of natural gas in Tanzania, the idea of setting up a gas-based ammonia/urea plant has gained importance. One fertilizer factory is now in operation, but it is dependant on imports for all of its basic raw materials, mainly ammonia, sulphur and phosphate rock. This factory is controlled by NDC, which is responsible for the development of chemical industries in general. For this reason a project was subcontracted in 1974 to NIDC of India with the aim preparing a fertilizer strategy for Tanzania. The final report on the project was entitled Report on the Fertilizer Master Plan for Tanzania: Volume I, Agro-economic profile; Volume II, Techno-economic Profile (see annex II).

As mentioned in chapter I of the present report, TPDC made a pre-feasibility study on a naphtha-based ammonia-urea plant presented in volume II of that report is no longer relevant. On the other hand, the assessment of agricultural development and the projections of fertilizer demand presented in volume I may make a valuable contribution to any future considerations on the expansion of fertilizer production in the country. With reference to the following chapter of this mission report, it should be noted, however, that efforts must be made to improve the country's fertilizer strategy. Before a recommendable solution can be found that would answer all the detailed questions arising in connection with the introgen fertilizer project, further studies of the agricultural development of the country will be needed.

As mentioned in chapter I of the present report, TPDC made a pre-feasibility study on the establishment of a natural gas-based nitrogen fertilizer factory in connection with the expansion of the Tiper refinery. The study recommends to set up a 300 tons/day ammonia plant and a 400 tons/day urea plant at the refinery at Dar-es-Salaam. Furthermore, it concludes that during the next phase of pre-investment investigation, a "feasibility study cum project report" should be prepared to provide data on the basis of whioh the Government could take the final decision on investment. The conclusions of the study follow from certain essential assumptions:

The projections on future fertilizer demand as worked out by NIDC in 1974 (annex III) are considered correct

Natural gas would be available at the factory site if the plant were located at Dar-es-Salaam

The plant capacity is justified by the total nitrogen demand estimated for 1985, namely 90,000 tons of urea, 15,500 tons of ammonia for production of ammonium sulphate at Tanga and 7,500 tons of ammonia for direct sales

Even if these assumptions would finally prove realistic, there appears to be time enough to choose the right moment to start implementation of the above project. As the assumed capacity is rather small by modern standards it may not be advisable to go ahead with establishment of a smaller unit of perhaps 100 or 200 tons/day to meet the country's small demand by 1980-1982. This possibility, however, should not be excluded. On the other hand, it appears too early to begin investment in a 300-tons/day or larger plant. From the technical point of view, a 200-tons/day ammonia plant combined with a 250-tons/day urea plant might be viable, although the project would become more expensive per ton of fertilizer. Studies conducted by various authors who have investigated the increase of production cost with decreasing plant capacity show clearly that the product of a 300-tons/day ammonia plant can hardly be competitive on the world market. The same applies to urea when manufactured in small plants. However, from the point of view of substitution of fertilizer imports and utilization of indigenous natural gas, which is the case in Tanzania, small-scale plants might be justifiable and profitable to the national economy.

Certain limitations to the options will have to be respected when studying the feasibility of the project and drawing final conclusions. A prerequisite for successful and profitable future operation of plants is the evaluation of a number of possibilities and alternative solutions before the decision is taken. Experience has shown that feasibility reports often omit some essential factors. Incorrect input data and assumptions that are unsupported by adequate experience are frequent causes of poor plant performance if compared with results promised by the feasibility report. In Tanzania, a small-scale nitrogen fertilizer plant would be economically viable under only certain conditions. All relevant factors must therefore be assessed very carefully in order to avoid misleading conclusions. If necessary, separate investigations on various aspects should be made to provide the Government with an all-around picture of an optimum development scheme.

The mission suggests examination of the following basic assumptions:

The magnitude of indigenous gas reserves is favourable for both the small- and large-scale manufacture of ammonia

The domestic market, although small at present and unaccustomed to consuming urea, will develop at a steady rate so as fully to justify the establishment of a relatively small ammonia/urea plant in the near future.

Development of nitrogen fertilizer production in neighbouring countries is not significant because of the absence of the most appropriate feedstock, namely, natural gas. At the same time, fertilizer demand in all these countries is growing steadily

When considering exports of surplus product to neighbouring countries, there will always be a transportation cost advantage as compared with imports to these countries from elsewhere. If, at the same time, production cost would be made competitive by setting up a large-scale plant, the project would doubtless become much more profitable than if it limited its capacity to supply local demand only

Pursuant the aforementioned basic assumptions, investigations to be made by government organizations, UNIDO consultants or by consulting firms should provide definite or alternative answers to the following items and problems:

Determination of the magnitude of the natural gas reserves

Scheduling the development of exploitation of the natural gas field and construction of the collecting system and pipeline to Dar-es-Salaam

Balance of expected use of gas, including alternatives for consumption of gas by ammonia plants of 200-, 300- and 600-tons/day capacity

Assessment of the gas Price (including estimates for 1980 and 1985)

Definite scheduling of the expansion of the Tiper refinery

Selection of the location of the nitrogen fertilizer plant, taking into account both sites considered by the Government (Dar-es-Salaam and Kilwa). For the location of Kilwa, as assessment of capital requirements for the development of infrastructure should be made. The share of investment relating to infrastructure to be included in the cost estimate of the fertilizer complex should be defined clearly. The development of roads, port facilities, energy and water supply and construction of housing will need to be considered. The gas-transfer line of approximately 50 km from the main line (bewteen Songo Songo Island and Dar-es-Salaam) to Kilwa should be included in the cost estimate. The Government may wish to give priority to a location other than Dar-es-Salaam, but the costs involved should be appraised in a comparative study that would consider the socio-economic advantages of establishing the plant in an undeveloped region. If justified, a third alternative location should be considered and evaluated

Assessment of differences in the average transportation and distribution costs of fertilizer between the pre-selected alternative locations of the plant and the consumer (co-operatives and district sales points)

Assessment of the reliability of the electric power supply and cost estimates on the construction of a captive power station. Alternatives for three plant sizes (200-, 300- and 600-tons/day) of ammonia, combined with the respective urea plants, should be evaluated

Appraisal of capital investment and operation costs for shipment by sea of the required quantity of liquid ammonia from the new plant to the existing fertilizer factory at Tanga (purchase of a seagoing vessel of approximately 2,500 tons capacity).

Overall appraisal of the assumed alternatives based on findings of the aforementioned detailed studies. At that stage a certain "battery limits capital cost" figure should be anticipated. As this comparative appraisal is independent of the future supply/demand balance, it can be undertaken without delay, thus providing the Government with substantive information for decisions to be taken before making the final decision on the ammonia/urea plant sizes and on inception of investment

Although it may appear excessive to make all these comprehensive studies, a clear answer should be identified to some of the inherent issues in order to decide:

Where to locate the plant

What provisions would have to be made if the fertilizer plant were to be attached to the refinery (anticipation of site development and off-site facilities)

What would be the magnitude of the additional costs that would be incurred by the Government if the plant were to be located in an undeveloped area (advance planning for investment in infrastructure)

Whether and when to undertake development of a new industrial area along with the fertilizer project

It may be noted that the above problems have almost no linkage with costs of development of the natural gas field, the construction of the main pipeline to the refinery and the expansion programme of the refinery as proposed by the UNIDO team of experts. For this reason the expansion programme may be implemented at an earlier date and will not be hampered by lack of decision on the location and capacity of the fertilizer plant. However, it is advisable to undertake the investigations as soon as possible because some interim results may prove helpful to prepare the proper layout of the supplementary plants at the refinery. The size of the natural gas pipeline will surely be adjusted to comply with standard pipe diameters. As concerns gas pipelines, it is normal practice to assume built-in spare capacity, either by increasing the diameter or anticipating an appropriate pressure-drop. For this reason no additional cost may be incurred (in comparison with cost estimates made by the UNIDO expert) if, as a result of the studies, a 600-tons/day instead of a 300-tons/day ammonia plant would be recommended for implementation. These considerations do not imply that only urea may be produced at the new fertilizer factory. Selection of the appropriate types of fertilizer and the plant size are discussed in the following section.

Development of the demand for chemical fertilizer

The use of chemical fertilizer is at a very early stage in Tanzania. According to statistics provided by the Marketing Department of the Tanzanian Fertilizer Company (TFC), total consumption in 1974 was about 82,500 tons, of which 34,000 tons were in the form of ammonium sulphate (AS) and 5,000 tons of ammonium nitrate sulphate (ASN), calcium ammonium nitrate (CAN) and urea. Approximately 50% of the fertilizers used were phosphates and nitrogen-phosphorus-potassium (NPK) compounds.

In 1975, 93,500 tons were distributed by three organizations: the National Farmers' Co-operative (NAFCO), through a grant from FAO, and the Tanzanian Rural Development Bank (TRDB), by direct import. Since TFC handles the major share of these transactions, the statistics that it provides constitute a good source of information on the development of existing Tanga plant. With increasing local consupmtion, however, there will be no significant exports in the years to come. Local supplies from the existing plant during its initial phase of operation, starting in 1971, were relatively small for a number of reasons. Present capacity utilization of the Tanga plant has reached almost 75% and presumably will attain 90% in the near future. The installed capacities comprise units for production of: 25,000 tons/year of triple superphosphate (TSP); 15,000 tons/year of diammonium phosphate (DAP); 20,000 tons/year of ammonium sulphate (AS); and 45,000 tons/year of nitrogen-phosphorus-potassium (NPK) fertilizer.

A major expansion programme of the existing factory is being implemented. It includes the elimination of some bottlenecks and the construction of an additional AS unit of 40,000 tons/year capacity. A small single-superphosphate (SSP) unit of 5,000 tons/year capacity is also included in the programme.

As has been noted, all of the major raw materials for these plants must be imported. Consequently, production must be limited to the demand of the domestic market. Without going into further details on the history of the Tanga plant and its running-in troubles, it may be assumed that, with the steadily improving interest of farmers in using more fertilizer and the on-going stabilization of the world market conditions as regards raw materials supplies and prices, the Tanga factory of TFC will cover a considerable part of Tanzania's supply/demand balance. At the same time, imports will increase over the years to come until the new natural gas-based nitrogen fertilizer plant goes on stream. However, production costs will not be sufficiently competitive to permit the profitable export of fertilizer from the Tanga plant.

It thus appears that, in the near future, after the completion of the expansion programme, the existing plant will be in a position to satisfy a major part of the growing domestic demand for fertilizer. The use of urea is at present rather low, and considerable educational work will have to be done by the agricultural extension services to prepare for a shift from the use of AS to urea. An essential disadvantage of the situation is that urea would have to be imported in increasing quantities to develop the market, while at the same time there would be a natural tendency to promote the consumption of AS in order fully to utilize the installed capacities at the Tanga plant. Consequently, it can hardly be expected that a sizeable market for urea will develop in Tanzania within the next three years.

Forecasts of fertilizer demand made by the NIDC study in 1974 are presented in annex III. It seems to be unlikely that consumption of nitrogen nutrients may increase threefold from the present level. On the other hand, however, there is no report available so far to provide a more realistic estimate. FAO has conducted a valuable study (annex II) on the present fertilizer distribution system in Tanzania. Recommendations on its improvement for 1976/77 were made. As appears from the report, consistent efforts are being made by the Government to eliminate any constraints to the increased application of fertilizer. The fertilizer subsidies provided by the Government constitute a considerable stimulus to the fertilizer promotion programme (annex IV). However, no sources of information are available for making realistic assessments of future demand. The economic effect of fertilizer application was studied by the University of Dar-es-Salaam; this institution might be able to provide forecasts on the future consumption of fertilizer. (The FAO country programme for Tanzania does not cover the forecasting of fertilizer consumption.)

In summary, with insufficient data available on future trends, it is at present impossible to make any recommendations on the quantities and types of fertilizer that should be manufactured in Tanzania. It is therefore indispensable to initiate studies on this subject as soon as possible to prepare basic data for a firm decision on the development of the fertilizer industry in general. The studies should be undertaken without delay. It would be superficial to assume that, as soon as urea becomes available from domestic production, its consumption will increase immediately. At present, the application of urea is below 4,000 tons/year; the smallest conceivable urea factory would supply 80,000 tons (250 tons/day). At the same time, the capacity of the AS plants

at Tanga will, by early 1978, reach 60,000 tons/year, which is equivalent to 12,600 tons/year in terms of nitrogen. Although these figures are apparently compatible with the nitrogen demand forecast made by NIDC, which takes into account a high utilization rate of the Tanga plants, there is no likelihood that the above quantity of urea will be absorbed by the local market by 1983. On the other hand, low utilization of the new ammonia/urea units cannot be anticipated because plant profitability is decreasing rapidly with the decline in its output. A 250-tons/day urea plant would not be profitable if utilized below 60% to 70% of its rated capacity.

Although it is usual that, in developing countries, the attainment of a reasonable level of plant utilization (between 80% and 90%) may take three years from start-up, the establishment of a 400-tons/day plant (132,000 tons/year) by 1982/83 would result in unacceptably high risks unless adequate export outlets were secured in advance. The best solution of the inherent problems should therefore be sought in subregional co-operation with neighbouring countries because, in this case, not only could optimum plant sizes be attempted, but also the profile of production could be diverisifed by including in its programme manufacture of AN and CAN as well as increased exports of liquid ammonia. AN and CAN can be produced interchangeably in the same plant. The dependence of production cost on the plant size and the respective capital investment needed is less distinct. Small AN/CAN units may represent viable alternative solutions to urea plants.

With respect to plant size, there are three possibilities. The choice will depend on conclusions of the aforementioned studies. However, should the Government prefer to substitute imports in the nearest future, a small-scale ammonia plant of approximately 200 tons/day capacity would be the only choice. A medium-sized (300 to 600 tons/day) or large-scale (of up to 1,000 tons/day) unit would surely be more profitable, provided subregional co-operation could be mobilized. The establishment of a small-scale plant would be feasible if it could be brought on stream in the shortest possible time, for example, before 1980 for a 100-tons/day unit or 1983 for a 200-tons/day one. The limiting factor would be the development of the natural gas field and the construction of the pipeline. It may be assumed that natural gas could become available at the factory gate by 1980, but if the demand projections made by NIDC prove realistic, nitrogen consumption will approach 200 tons/day by 1983. Even then, the skid-mounted plants of 100-200 tons/day offered presently might not be

advisable; they are fairly expensive per ton of finished product. Alternatively, non-sophisticated Chinese nitrogen plants of this size (approximately 54,000 tons/year) could be purchased at much lower cost. There might be also an opportunity to re-deploy existing equipment from Japan or elsewhere at very low cost, but scheduling will remain the critical issue. If the consultants appointed by the Tanzanian Investment Bank (TIB) recommend a small-scale unit, the mission will strongly recommend that the other opportunities be investigated as well. In any case, the small unit cannot be considered adequate to cover future demand for fertilizer beyond 1985. If the financing of the project were the limiting factor, the medium-sized plant (300 to 600 tons/day) would be the choice, starting up between 1983 and 1985.

From the point of view of capital cost versus production cost, the best choice would be a large unit (600 tons/day ammonia capacity). This plant size, however, cannot be recommended unless firm supply agreements are made with neighbouring future importers of the surplus product. As there will be no raw materials constraint, the 600-tons/day unit seems to offer an acceptable compromise for the long run; that is, at least until 1990.

IV. ENERGY RESOURCES

Nitrogen fertilizer plants need highly reliable supplies of electric power. There should be no future power shortage in Tanzania if the present energy development plans are carried out on schedule. Although natural gas should not normally be used as fuel for power stations in Tanzania, it is strongly recommended that an exception be made when establishing the fertilizer factory. There are well-known examples world-wide where the low-capacity utilization of fertiliser plants in developing countries was attributable to discontinuity of power supply for extended periods. When considering the establishment of the ammonia urea plant, the requisite captive power plant should not be ommitted.

A team of World Bank experts is conducting a study on the utilization of the energy resources of Tanzania and is forecasting the supply/demand balances for 30 years ahead. Tanzania has considerable coal deposits and hydroelectric power resources that will be used to satisfy the country's future energy requirements. However, even if an increased potential in this sector were to develop, the reliability of the grid might not be adequate to satisfy the specific requirements of the fertiliser plants. The power consumption of the plants may be estimated at 15 to 30 megawatts. By and large, this is not a large amount but it may consitute a considerable share of the total consumption of a particular area that is not highly industrialized.

These recommendations should be taken into consideration by the consultants who will be assigned to prepare the pre-investment design and cost estimates. It is known as well that feasibility studies carried out by contracting or consulting firms are treating this essential subject as one of minor importance because it does not relate directly to the scope of work they are assumed to cover and for which they are responsible. Power shortages are beyond the liabilities of the contractors who are involved mainly in bringing in and erecting the plant. However, the plant owner should be made aware of the consequences of his dependence on a weak power-supply system. The presentation of the above comment appeared necessary after discussions held at various organizations in Dar-es-Salaam, where some opinions were expressed that showed inadequate understanding of the inherent problems. The importance of a reliable power supply should be emphasized from the very beginning.

V. ACTIVITIES OF NDC, TIB, INDCENTRE AND STAMINCO

The National Development Corporation (NDC)

NDC is presently in charge of operating and developing the following industrial subsectors:

Leather
Tobacco and beverages
Printing, packaging, and pulp and paper
Chemicals
Metalworking
Miscellaneous industries

The production of fertilizer is included in the field of activities of NDC, and at present expansion of the Tanga fertilizer factory is being backstopped by this organization.

The ammonia/urea project is not envisaged so far in the NDC list of projects under consideration. Although the aforementioned study on establishment of a naphtha-based nitrogen fertilizer plant was subcontracted by NDC to NIDC, no follow-up action was taken to implement the project or to adjust the findings of NIDC to the new situation that prevails after the discovery of indigenous natural gas resources. The new natural gas-based fertilizer project that was proposed for the first time in late 1975 by UNIDO experts at TPDC has not come to the attention of NDC. This may be due to the fact that the establishment of the factory was hitherto linked in principle to the expansion of the Tiper refinery, which in turn was dependent on decisions, yet to be taken, on investment in the development of the natural gas field and the construction of the pipeline. A review report prepared by the Manager of the Development Division of NDC for presentation at the Group General Managers' Conference in November 1976 highlights NDC's strategy for setting up new industries.

The following excerpt from the managers' statement shows clearly the attitude of NDC on industrial development projects:

> "Development and implementation of projects by NDC had made some departures from the old style. The present emphasis is to involve practitioner groups right from the start of project development through implementation and initial operation. Also, to avoid pre-appraisal delays, financing agencies are being involved early in the project development, especially for large projects. In importing technologies from outside, which is inescapable at the present stage of development, special care is taken to have labour-intensive technologies suited to our local situations.

"The group executives are called upon to make contributions in technology selection and development. When one unit is already working in a given subsector, further development should then centre around the unit. Also, the group companies should be able to develop and supply the required managerial and technical skills in the respective fields. The autonomy that is being given to group companies should enable them to stand up to this expectation."

Most projects being implemented by NDC are of relatively small scale if compared with the investment requirements for the new fertilizer factory. However, in the chemical sector of NDC, a large-scale pulp and paper project is under advanced investigation. Investment is estimated at 1,818 million Tanzanian shillings (TSh) (about $227 million). The mission is of the opinion that the NDC would be in a position to undertake the fertilizer expansion programme if the Government were to choose this option. The selection of the executing organization will depend on certain prerequisite factors that would have to be considered by the Government. These concern mainly alternative plant locations and the organization of the project:

Location of the plant at the Tiper refinery (preferable executing organization: TPDC)

Location of the plant in a new industrial area (preferable executing organization: NDC or a new independent company)

Joint venture project to be executed by a new organization that would be independent of both TPDC and NDC.

Whatever the Government's final decision may be, it appears advisable to set up, as soon as possible, an operational unit either at NDC or TPDC to take care of preparatory work for the steps that must be taken by the Government to organize project implementation. In this connection, attention is drawn to the strategy followed by NDC in accordance with the manager's statement quoted above. The approach of NDC may not be suitable for undertaking this complex task in a way similar to that adopted for smaller projects. For this reason, the various pre-investment studies and consultancy services should not be committed to the future contractor of the fertilizer project. There will be enough time to go through the exercise of international bidding for selecting the most appropriate consultants and contractors to implement the project.

When setting up the operational unit, which may be composed of three or four professionals at the initial stage, the appointment of a UNIDO consultant should be considered. His terms of reference would cover all aspects of consultancy services needed to carry out the preparatory work and to provide advice at all stages of project implementation.

The Tanzania Investment Bank (TIB)

TIB intends to establish a unit that would organize pre-project investigations and the evaluation of projects. For this purpose, a World Bank loan of $5 million was made available to TIB. The Investment Co-operative Programme Office - World Bank/UNIDO co-operative Programme - was advised about the possibilities of associating UNIDO with the loan, but no action on the part of TIB has been forthcoming. An Indian firm, Tata Engineering Ltd, was assigned by TIB to act as consultants to it and to set up the unit, whose function is assumed to cover:

Making arrangements for the subcontracting of feasibility studies and techno-economic appraisals on industrial projects

Evaluation of feasibility studies

Assessment of the viability of projects.

During the discussions held at TIB it was mentioned that, at an earlier stage, UNIDO was not in a position to organize or staff the project unit at TIB. Owing to the good relations between the Tanzanian authorities and UNIDO and the excellent experience gained so far when co-operating with UNIDO experts, the active involvement of UNIDO in the work of the new TIB unit is being considered. However, it may take some time for the unit to become fully operational.

As concerns the fertilizer project, TIB is considering subcontracting the feasibility study to the contractor who is providing consultancy services on small-scale fertilizer plants. Expansion of the Tiper refinery and construction of the gas pipeline will not, presumably, be financed through TIB, but the fertilizer project might be of interest to them. Pursuant to findings of this report, the Chemical Industries Section of UNIDO's Industrial Operations Division may continue to keep in touch with TIB to provide advice on how to organize the project in co-operation with other Tanzanian institutions and when to request the direct involvement of UNIDO in preparing and/or evaluating the relevant pre-investment appraisals. Close relations with TIB are also desirable in connection with other industrial studies that will be considered for financing from the World Bank loan.

As a large investment potential is arising out of the natural gas development programme, it appears advisable for TIB to initiate a long-range, action-oriented programme pertaining to the development of the fertilizer and petrochemical industries.

The Industrial Studies and Development Centre (INDCENTRE)

INDCENTRE has conducted a considerable number of studies on the development of various industrial sectors. Although it now appears difficult to obtain copies of the relevent reports, in the near future, after the restructing of some of its internal services and the moving of its office to another building, it will become easier to take advantage of the valuable work carried out so far by the INDCENTRE. Up to now, it has not been requested to undertake a study of the nitrogen fertilizer project. This is understandable, since no organization was assigned to initiate concrete action in this respect. Reports and surveys worked out by the INDCENTRE are designed to solve specific problems arising from development projects. The type and scope of such studies would be suitable also for preparation of the fertilizer project at the pre-investment stage. The services of INDCENTRE should be requested for detailed studies on particular topics that otherwise would be covered only inadequately by consultants who might be assigned to make the techno-economic appraisal of the project. Some of these studies have already been mentioned in this report. More detailed investigations could be made by INDCENTRE on the following topics:

Assessment of distribution costs of fertilizer manufacture at the three alternative locations: Dar-es-Salaam, Kilwa and Tanga

Assessment of the capital investment requirements for the expansion of harbour facilities at Kilwa and the construction of a loading jetty for fertilizer and liquid ammonia

A study on the establishment of an industrial development area in the Southern Region

Pre-project design for the development of the existing distribution system, including bulk transportation, expansion of field storage facilities, loading and unloading equipment, transportation facilities etc.

Assessment of development of the existing phosphate fertilizer capacities at Tanga until 1990 and proposals on alternative schemes for co-operation between the Tanga factory and the new nitrogen fertilizer plant.

It may be noted in this connection that two UNIDO consultants are presently working for INDCENTRE. However, INDCENTRE should be encouraged to request expansion of UNIDO's assistance to conduct the aforementioned specific studies. In this connection, attention is drawn to the Plan of action later in this

report, where the steps to be taken prior to contracting the plant are listed in sequence. The conclusions of the aforementioned studies will not only facilitate the making of correct decisions but also throw light on the extent of development of the infrastructure that will be needed in connection with the fertilizer project. INDCENTRE has conducted a number of studies relating to fertilizer, while at the same time other organizations are either entrusting relevant studies to external consultants or carrying out the work by their own means. Although it may sometimes be desirable to have a particular subject examined from different viewpoints, the co-ordination of investigations seems to be highly desirable in order to avoid the overlapping of work. For this reason, the mission recommends allocating to INDCENTRE a central position for co-ordinating pre-project investigations in view of the large number of detailed studies needed.

The State Mining Corporation (STAMINCO)

STAMINCO is considering the implementation of a phosphate rock mining project at Minjingu. A considerable number of studies were conducted so far by various foreign consulting firms and locally by INDCENTRE and by STAMINCO itself. The list of reports on the subject (annex II) gives evidence that STAMINCO is well equipped to conduct preparatory work. Although the deposits of phosphate rock discovered in the country are relatively small, exploitation of this indigenous source of raw material for processing at the existing Tanga fertilizer plant appears fully justified from the point of view of import substitution and conserving foreign currency. As appears from the numerous reports received, several technical problems will need to be solved to adjust the processes employed at Tanga to the new material, which will be of lower quality than the standard type of imported phosphate rock. Furthermore, high transportation costs from the mining site will be incurred because of its distance from the nearest railway terminal. At the initial phase, extensive investment in connection with the mining and beneficiation of rock seem to be unjustifiable. Nevertheless, the project has a sound background and might well contribute to the development of the national economy. In spite of the numerous difficulties to be expected, the project represents a reasonable attempt to utilize natural resources in a practical way. It may be anticipated that the latest survey and laboratory research being presently conducted by a Romanian mining organization will provide appropriate data and advice that should enable STAMINCO to initiate mining operations and the beneficiation of the phosphate. The final report on the survey is expected in early 1977.

In summary, no urgent assistance from UNIDO is needed in this respect. Nevertheless, STAMINCO should be encouraged to request UNIDO's advisory services for project management, including assistance to the Tanga fertilizer factory. The management of TFC is interested in processing indigenous phosphate rock and is aware of the difficulties involved. The company has shown willingness to carry out full-scale application tests, but STAMINCO must first go ahead with mining of the crude rock. This work, however, may not start soon, thus causing delay in TFC's programme aiming to adapt their facilities to the use of local rock.

As STAMINCO is satisfied with assistance provided by UNIDO and the United Nations Office for Technical Co-operation (UNOTC) experts on salt and coal mining, it appears advisable to maintain continued co-operation with UNIDO by including a pertinent item in the country programme for 1978-1981. In this connection, the mission suggests taking up the matter again after conclusion of the Romanian survey. It also suggests that a copy of the survey report be sent to UNIDO for evaluation.

Financing arrangements and involvement of the World Bank

As mentioned previously, considerable work will have to be carried out to prepare a bankable project for the establishment of the nitrogen fertiliser complex. As regards financing possibilities, the investment plans of Tanzania are, in general, overcommitted. However, in pursuance of recommendations made in this report, discussions on financial arrangements in connection with the fertilizer project may not be initiated before late 1978. At present, it appears too early to suggest that the matter be taken up by the World Bank. Furthermore, there may be ways of financing such a large-scale undertaking. Three basic problems must be resolved by the Government to start the project in the right direction. These are:

Should immediate action be taken to set up a small-scale plant?

Should the project take account of subregional co-operation?

Should the project be implemented as a subregional joint venture, or would a joint venture with other external participation be preferable?

In any event, the implementation of the project will have to await the pending decisions on investments of considerable magnitude to begin the

exploitation of the natural gas field, the construction of the pipeline and the expansion of the Tiper refinery. This report suggests that attempts be made and emphasis be given to establish a plant of optimum size by present standards, even if, for this reason, it would not be possible for it to come on stream before 1983. A possible alternative is the construction of a smaller plant that could be brought on stream sooner. However, the financial implications should be studied very carefully, since the profitability of small-scale fertilizer projects is limited. The financing of the pipeline cannot be covered by the fertilizer project and must be considered separately or in conjunction with the Tiper refinery expansion programme. On the other hand, the construction of the pipeline for the ammonia/urea plant separately from the refinery expansion project might be justifiable, provided that a very large-scale plant could be considered economically viable. This, however, is unlikely to be the case, because the world market will presumably be too weak in the period 1980-1985 to absorb large additional quantities of fertilizers from that plant, and the subregional market may not be favourable enough to permit construction of a complex larger than 600 tons/day and 1,000 tons/day of ammonia and urea capacity, respectively. The study recommended earlier, in the section "Development of the demand for chemical fertilisers" regarding the prospects for long-range development of fertilizer consumption in Tansania and the subregion may be assumed to provide a definite answer to the problem of what size of plant should be given preference.

VI. THE MINISTRY OF INDUSTRIES

Findings of the UNIDO mission were presented at a meeting with the Minister of Industries, in the presence of the UNIDO Senior Industrial Development Field Adviser and the responsible programme officer of UNDP. The Ministry was of the opinion that the consumption of fertiliser in Tanzania is bound to increase at a higher rate than has been experienced to date. The settlement of people in the countryside is regarded as virtually completed. The modernization of agriculture based on village production units will go ahead consistently and establish a new trend line of growing demand for fertilizers. At the same time, it is being assumed that the market for fertiliser will become diversified and favourable for the development of the fertiliser industry.

For this reason the Ministry expressed the desire to obtain technical assistance from UNIDO in developing a fertilizer strategy with the target date of the year 2000. The project is expected to examine all relevant aspects of:

Raw materials supply and the development of natural resources
The manufacture of fertilizers
Marketing and distribution
Supplementary imports or balancing exports
Agricultural development and the improvement of extension services.

As concerns manufacture of fertilizers, the existing production facilities (that is, the TFC plants at Tanga) will have to be reviewed and a critical assessment will have to be made on the future development of their operations. Furthermore, the Ministry would appreciate the advice of UNIDO on the utilization of petroleum by-products from the Tiper refinery, the processing of the coal to be mined in the Mbeya-Songea area and on exploitation of the natural gas fields at Kilwa (Songo Songo Island). It was mentioned that development of the energy sector may have a positive impact on expansion of the fertilizer and chemical industries, as may also the discovery and development of some mineral resources.

Furthermore, advice was requested on fertilizer technology, manpower requirements, training programmes and on the mobilization of the necessary financial resources to implement a phased, long-range fertiliser development programme. The view was expressed that advice would be necessary on future

development of the chemical industry in general, thus linking the development of the fertilizer industry, the results of exploration for oil and gas and the expansion of existing chemical processing capacities, with the development of basic chemicals industries that must be established in accordance with a natural trend towards an increasing demand for chemicals.

While appreciating the integrated approach suggested by the Government, the mission emphasized that subregional co-operation with neighbouring countries should be given serious consideration. In the long run, external co-operation will become a prerequisite for the successful development of the Tansanian nitrogen fertilizer industry and possibly other chemical industries based on indigenous resources of natural gas, which at present appear to be the only ones discovered in the East African subregion.

The mission drew attention to UNIDO's willingness and preparedness to implement the fertilizer strategy project and suggested that the project be allocated adequate priority when formulating the final draft of the Second Country Programme of UNDP. Also, the mission emphasised that there is a need for the Government to take immediate steps to begin the development of the fertilizer industry, as outlined in this report, in parallel with the development of exploitation of the natural gas field, and the Tiper refinery expansion programme.

VII. THE PLAN OF ACTION

The following plan of action is based on recognition of the important fact that a nitrogen fertilizer project is feasible in any developing country that has adequate reserves of natural gas and a growing market potential to absorb the product yielded after completion of the appropriate plants. Furthermore, it is being assumed that the project is technically viable and will prove profitable, provided that the plants will be operated at a high rate, that is, that the off-take of finished products will not be hampered by market constraints. For this reason, the two prerequisites of successful management of this project are:

Choice of the right moment to begin its implementation

Identification of all inherent factors well in advance in order to ensure the achievement of the targets set by the project and to implement infrastructural development projects before the plant comes on stream.

These principles are fully applicable to the planned development of the fertilizer industry of Tanzania. Feasibility studies tend to be superficial and not very useful if not followed up immediately by an action-oriented programme. This report recommends the initiation of preparatory work as soon as possible, although it may seem that a nitrogen fertilizer project that would satisfy Tanzania's future demand may not be advisable before 1983. However, because of the considerable number of investigations that must be made, there is little time to be lost if the right decision is to be taken by the Government.

In brief, the following steps must be taken, and the interim results of investigations must be considered by the Government before any contract on plant supply and erection can be approved and signed.

Task I

(1) The appointment of a planning team responsible for project management and control (see note 1 below)

(2) Selection of issues to be investigated in detail (pre-project studies)

(3) Subcontracting the studies (see note 2 below):

Plant location (three alternatives)

Infrastructure development at the national level (master plan for establishing a new industrial area)

Infrastructure development and off-sites at the company level

Environmental considerations

Transportation network and operating costs (development of roads and ports; procurement of trucks, barges etc.)

Fertilizer demand forecasts for 1980-2000 and agricultural development relating to fertilizer consumption. (agricultural development strategy)

Development of the agricultural infrastructure and of extension services relating to the distribution of fertilizers from present and anticipated new capacity

(4) Backstopping and evaluation of studies (review of interim and final reports)

Task II

(1) Identification of a strategy for the development of chemical industries in general and of the fertilizer industry in particular (see note 3 below)

Task III (see note 4 below)

(1) Identification of a project concerning subregional co-operation among East African countries in the production and distribution of chemical fertilizers

(2) Calling an intergovernmental conference on subregional co-operation among the countries of East Africa

(3) Identification of possibilities of establishing a subregional joint venture project

(4) Signing subregional or bilateral intergovernmental agreements

Task IV

(1) Establishing an engineering group or company to carry out the pre-project design of the fertilizer complex (see note 5 below)

(2) The collection of relevant technological data on the plant

(3) Preparation of a project report on plant size and location, based on the above-mentioned studies, and preliminary assessment of capital investment and operating costs. Preparation of essential data for consideration by the Government and making an interim decision if one is required at this stage

(4) Preparation of a summary report on alternative proposals regarding the development of infrastructure. Preparation of the Government's decision

Task V

(1) Endorsement of the development strategy by the Government (chemical and fertilizer industries)

(2) Endorsement of the fertilizer project by the Government, in principle, including endorsement of measures to be taken for the development of infrastructure

Task VI

Pre-project (preliminary) design of the plant (see note 5 below)

Preparation of tender specifications and documents, and pre-selection of bidders

Evaluation of tenders and selection of the contractor

Techno-economic appraisal of the fertilizer project (final, based on actual cost data (tenders), pre-project design and studies on infrastructural development)

Task VII

Final endorsement of the project by the Government

Obtaining authorization from exchange-control authorities for payments in foreign currencies and/or financial arrangements with lenders, international financing institutions and the like

Task VIII

Contract negotiations

The contract and/or subcontracts

The key items of this plan of action are the following:

Task I, item 1	Task V, items 1 and 2
Task II, item 2	Task VI, items 1 and 4
Task III, items 2 and/or 4	Task VII, item 1
Task IV, item 1	Task VIII, item 2

It may be noted that the above plan assumes the development of the skills of the local staff, specifically as concerns the management of the project and engineering during the preparatory phase. Such development can only be effected if the management team and engineering group are appointed in advance of project implementation. The plan is applicable as well to the expansion programme of the Tiper refinery and any further development of oil- and gas-based production of chemicals and of chemicals based on locally available minerals. It should be kept in mind that the development programme, which now appears viable, will entail capital investment exceeding several hundred million dollars. It is therefore justifiable to take advantage of the opportunity to develop engineering skills from the very beginning. While the engineering group of trainees would surely not be involved in the process engineering of the plants, a number of detailed projects could easily be carried out by properly guided local staff. Industrial civil engineering and planning of off-sites may be assumed as one of the basic initial tasks to be undertaken locally. Preliminary design should be based on information made available by contractors in the form of tender specifications and drawings. The plan of action may be simplified to some extent if the preliminary studies indicate that there is scope for a small plant only. In any case, however, it is not advisable to simplify the whole work by committing a few items of the list to a contractor and making decisions according to his recommendations.

The following notes, to which reference was made in the listing of tasks I through VIII, should be considered in connection with the above Plan of action:

Note 1. (task I, item 1) The team of three professionals should be guided by one foreign expert. It may be involved directly in conducting studies as per task I, item 3.

Note 2. (task I, item 3) Some of these studies can be carried out by Tanzanian organizations such as INDCENTRE, Dar-es-Salaam University or TFC. Additional foreign assistance may be needed.

Item 3 of task 2 should be implemented jointly with FAO experts. It appears advisable to consider the establishment of a soil institute whose terms of reference should include making recommendations on fertilizer application with respect to soil conditions and crop planning.

Note 3. (task II, item 1) UNIDO assistance should be requested on a priority basis. The project should be considered for implementation from Indicative Planning Figure (IPF) funds of UNDP, since $250,000 was earmarked for a possible project entitled "Assistance in Processing Natural Gas" (DP/URT/75/042) (annex II). A six man/month mission of a UNIDO expert would be appropriate to conduct investigations and define the long-term strategy as requested by the Ministry of Industries.

Note 4. (task III) There are several ways to attack this problem. A regional project might be attempted, if UNDP were to respond positively to this idea. The Economic Commission for Africa (ECA) may be approached to include the project in its working programme on regional development. A third opportunity might be provided by UNIDO's system of consultations. In any case, the Government should initiate action by requesting UNIDO assistance. Pursuant to this, UNIDO may initiate preparation of the project by formulating terms of reference and cost estimates to facilitate financial arrangements for convening a sub-regional fertilizer conference in the near future.

Note 5. (task IV, item 1) This item calls for the establishment of a long-term assistance programme. Although it is understood that the most practicable way to establish the engineering group would be to expand an existing unit, much foreign expertise on the engineering of chemical plants would be needed to develop indigenous skills. For this reason the mission recommends the inclusion, in the second country programme, of a large-scale project to assist the Government in establishing the engineering unit. At the beginning, the unit may be staffed by 20 to 30 engineers of various specialities, draftsmen and auxiliary personnel to undertake simple design work for existing plants. Later, the unit may develop in parallel with the implementation of certain investment projects at the refinery and the fertilizer complex or any other chemical plant to be established in Tanzania.

UNIDO assistance might be requested for a duration of five years at a cost of approximately $1.2 million, thus providing a sound foundation for the development of local design capacities and future self reliance in the engineering of industrial plants.

In concluding these recommendations regarding implementation of the plan of action, it cannot be overemphasized that development of the industrial production capacities should not be undertaken without developing, at the same time, indigenous engineering capacities, although it may take five to ten years to attain a reasonable level of practical qualifications. This should not discourage the Government from initiating positive action immediately. The future outlook for a growing demand for chemicals appears favourable. Since Tanzania is a large country with a population of approximately 15 million, and since it is fairly well endowed with basic raw materials, it will surely attempt to become self-sufficient as regards basic chemicals and fertilizers. However, together with the purchase of complete plants and equipment, considerable design and construction work will have to be done for which local abilities should consistently be developed in a practical way. The long-term result thus achieved will be markedly less costly than continued reliance on foreign companies that undertake assessment of the feasibility, design and engineering of the plants, and supply of equipment, without transferring their knowledge and experience to the local staff.
Strong emphasis must therefore be laid on development of engineering skills and experience at the working level. For this purpose an organization is needed that can be asked to appoint its personnel to any project during the preparatory phase, even if the engineering will virtually be carried out by a foreign company. Local designers will thus become qualified to undertake supplementary engineering when needed to improve the operation of the plants purchased as complete units. The experts in the industrialized countries who now conduct feasibility studies and provide consultancy services have gained their experience, to a considerable extent, while employed by engineering and contracting companies. Consequently, this report strongly recommends that, in addition to the training of management and operators of chemical plants, which is usually included in contracts and conducted by the licensor or owner of the technology, the development of engineering skills should not be neglected.

Annex I

PERSONS MET AT DAR-ES-SALAAM

UNDP	G. Grisogono, Resident Representative of UNDP
	O. Arefalk, UNIDO Assistant, Senior Industrial Development Field Adviser
	K. Holst, UNDP Programme Officer
UNDP/FAO	W. B. Ramamurthy, FAO Country Representative
UNDP/UNIDO	G. Kastengren, Senior Industrial Development Field Adviser (Nairobi/Kenya)
	M. V. Rujwade, UNIDO Economic Adviser to TPDC
	K. Narayanan, UNIDO Technical Expert to TPDC
MINISTRY OF INDUSTRY	C. D. Msuya, Minister of Industries
	J. S. Mujuni, Director of Industrial Operations
NDC	S. I. Husain, Director of Development
	S. Hamisi, Director, Production Division
TIB	J. R. Msuya, Director of Planning and Development
INDCENTRE	B. Edman, Financial Analyst (UNIDO)
STAMINCO	S. L. Iwatakare, General Manager
World Bank	K. Hanson, Resident Representative
TFC-Tanga	R. Kramm, General Manager

Annex II

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Annex III

PROJECTED DEMAND (TONS) FOR NITROGENOUS FERTILIZERS IN TANZANIA, 1974-1983

Year	Minimum demand (using modified) trend method) A	Maximum demand (using modified area crop method) B	Most likely demand (mean of A and B)
1974	13 113	13 738	13 426
1975	15 080	16 049	15 565
1976	17 342	19 708	18 525
1977	19 943	23 668	21 806
1978	22 934	28 425	25 680
1979	25 800	31 748	28 774
1980	29 025	35 558	32 292
1981	32 653	39 825	36 239
1982	36 735	44 604	40 670
1983	41 327	49 956	45 642

Source: Report on Fertilizer Master Plan for Tanzania, National Industrial Development Corporation Ltd, New Delhi, 1974.

Annex IV

FERTILIZER PRICES AND SUBSIDIES IN 1976

Fertilizer types	Distribution forecast (TSh/ton)	TFC selling prices and transport cost (TSh)	Farmers' purchase price (TSh)	Subsidy a/ (TSh)	Total subsidy (thousand TSh)
Nitrogen					
SA	42 000	2 000	1 000	1 000	42 000
CAN	7 270	2 500	1 250	1 250	9 090
Urea	2 425	3 200	1 600	1 600	3 880
Potash	500	2 000	1 000	1 000	500
Phosphates (TSP)	20 000	2 800	1 400	1 400	28 000
NPK	27 805	2 800	1 400	1 400	38 930
Totals	100 000				122 400

Source: TFC and Kilimo.

a/ 50%, transport costs included.

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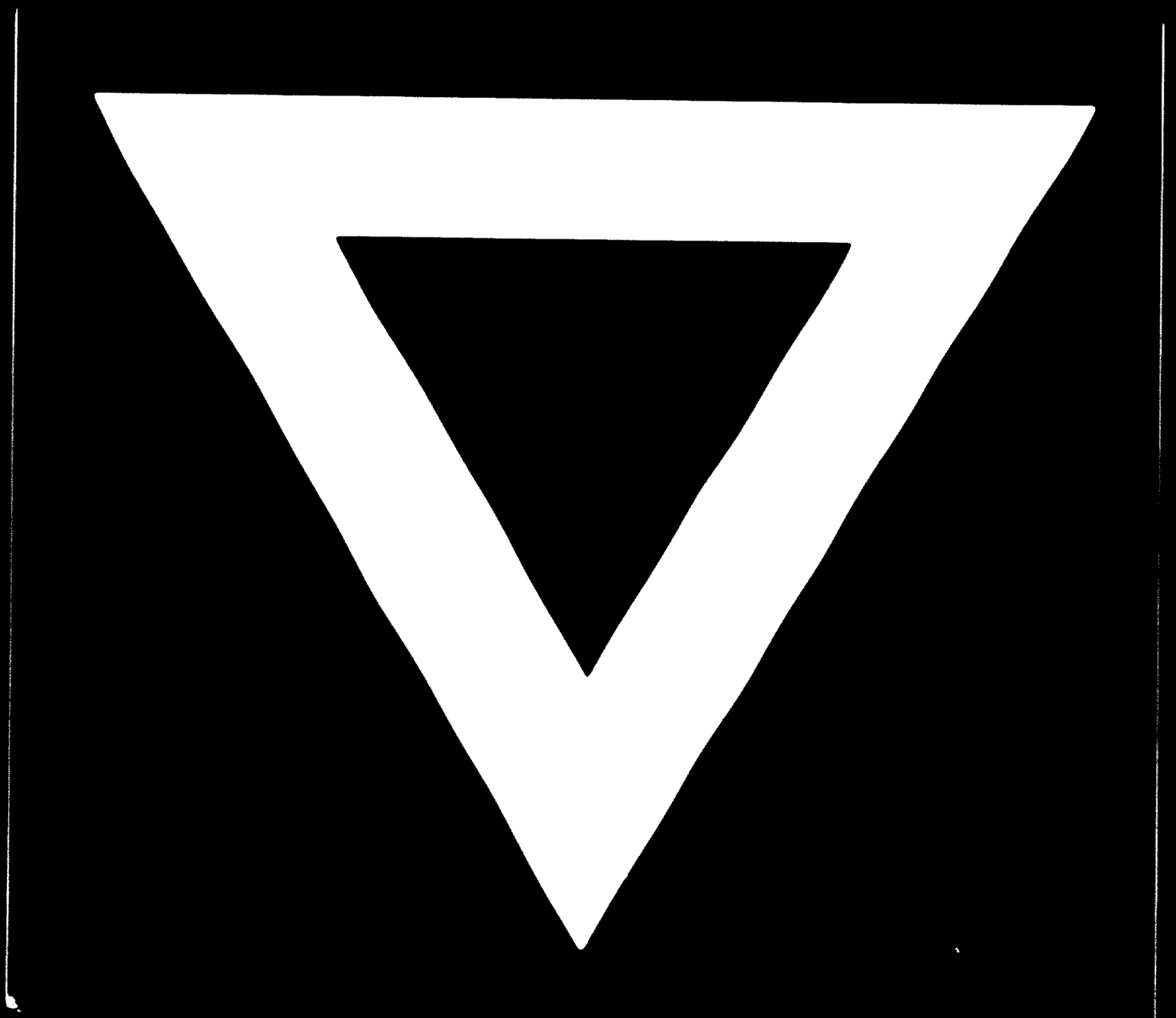

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