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INDICATIVE PROGRAMME FOR THE INTEGRATED DEVELOPMENT OF THE FERTILIZER INDUSTRIAL SYSTEM IN THE UNITED REPUBLIC OF TANZANIA

A PROGRAMME PROPOSAL

DRAFT

Programme Development Support Unit
United Nations Industrial Development Organization

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CONTENTS

Preface

The author of this report was sent on mission to Tanzania from December 28th 1989 to January 12th 1990. The author wishes to acknowledge the excellent co-operation of the Tanzanian counterpart organizations in the preparation of this Indicative Programme Proposal. Special thanks are given to Tanzania Fertilizer Company Limited, National Chemical Industries, Ministry of Industry and Trade, State Mining Corporation, Ministry of Agriculture and FAO as well as to UNDP in Dar es Salaam. The author also wishes to express his appreciation for the co-operation received from staff at UNIDO's Division for Industrial Operations.

A. PROGRAMME DESCRIPTION.

SUMMARY

1. PROGRAMME CONTEXT

1.1. Description of the main components and linkages of the fertilizer industrial system in Tanzania.

In order to better describe the importance of the fertilizer industrial system to Tanzania relevant general information on this country is presented below. Tanzania is a sea-side located country in Eastern Africa with a total area close to 1 million sq km. The dryland area is 884,000 sq km, of which 7% is estimated to be under cultivation, and only 3 per cent of this area is irrigated.

There are 19 agricultural regions in Tanzania, namely Arusha, Coast (DSM), Dodoma, Iringa, Kagera, Kilimanjaro, Kigoma, Lindi, Mara, Mbeya, Morogoro, Mtwara, Mwanza, Rukwa, Ruvuma, Shinyanga, Singida, Tabora and Tanga. The area under cultivation in each region varies from 166,000 ha in Kigoma to 630,000 ha in Shinyanga.

Soil erosion and deforestation are the most important constraints on arable land increase. Soils are generally acidic, easily leached and deficient in plant nutrients.

Much of the country has a low and erratic rainfall. In the fertile north and south west there are light rains during November and December and heavy rains from March to May. Droughts contribute to periodic food shortages.

The mid-1988 population is estimated at 24 million inhabitants, with population growth at 3.4 per cent per annum. A life expectancy of 53 years is above average for sub-Saharan Africa as is the daily per capita calorie intake of 2,316 Kcal (2,097 Kcal for sub-Saharan Africa in 1986). Nevertheless, the average per capita calorie intake is insufficient, and UNICEF estimates in 1980 indicate 43 per cent of children having mild to moderate malnutrition and 7 per cent having severe malnutrition.

The country has a very low GDP per capita of $ 204 (1986) and real growth of GDP of 1.0% in 1986. Inflation stood at 32.4% in 1986, while in the same year Tanzania experienced a trade deficit of $ 566 million and a foreign debt of $ 4.2 billion. Economic decline has been caused by many factors, the most important of which include oil price shocks, falling prices of Tanzania's major export commodities, repercussions from compulsory villagisation programmes, lack of incentives to smallholders as prices paid to agricultural producers lagged behind inflation, scarcity of basic consumer goods as incentives for farmers to raise production, lack of transport equipment, fuel and spare parts which contribute to difficulties in the collection of crops (leading to high wastage rates) and the distribution of essential inputs, such as fertilizers.

Agriculture is the mainstay of the Tanzanian economy, contributing almost 50% of GDP and up to 80% of export earnings, as well as employing over 90% of the labour force. Low world demand, storage, transport and distribution problems, have tended to turn farmers away from cash crops (coffee, cotton, tobacco, cashewnuts) and towards subsistence crops (maize, cassava, bananas and plantains).

The inadequacy of the transport system has acted as a severe constraint on increasing inputs to agriculture. Tanzania is a large country with a widely dispersed population and the efficient functioning of the economy requires the movement of goods over large distances. Many new agricultural export areas and remote areas with good soils and quite good rainfall still have rudimentary transport systems.

Of 50,000 km of roads only 2,700 km are bituminised, and average road density both per 1,000 inhabitants and per 100 sq km of total land area is among the lowest in Africa. The main rail network consists of some 3,000 km of track. The main rail lines link Dar es Salaam with Zambia (designed with a capacity of 2 million tons per annum), Dar es Salaam with central and northern regions to Lake Tanganyika, and Dar es Salaam with Tanga and Arusha in the northern part of the mainland. The principal ports are Dar es Salaam, Tanga, Mtwara and Lindi. The port at Dar es Salaam handles considerable cargo for Tanzania, Zambia, Burundi, Rwanda, Uganda and Zaire. After modernization (with World Bank support) cargo handling capacity will rise to 4 million tons annually (see attached map for reference).

The ports at Dar es Salam and Tanga, with their associated rail network, play a key role in the development of the fertilizer industrial system as they handle the majority of fertilizer related raw materials and final products from both domestic production and imports.

The mining and energy subsector in Tanzania, of vital importance for the development of the fertilizer industrial system, contribute only marginally to GDP (below 2%). A phosphate mine at Minjingu in northern Tanzania, supplying the fertilizer complex in Tanga, and natural gas deposits discovered at Songo-Songo island and at Kimbiji are of central importance for the development of the fertilizer industrial system in Tanzania, and possibly in Eastern Africa as a whole. The natural gas deposits are planned to supply ammonia production at Kilwa Masoko.

Tanzania is heavily dependent on foreign grants and loans which account for about 40% of government expenditure (1988/89). Transport has headed the list for funding from the recent inflow of aid, as donors realise its crucial role in facilitating agricultural exports. All fertilizers imported to Tanzania take the form of grants. Tanzania's main bilateral donors are the Scandinavian countries, the UK and West Germany. Multilateral assistance is provided mainly from the World Bank and UN funds.

Tanzania belongs to the Southern African Development Coordination Conference (SADCC) and the Preferential Trade Area for East and Southern Africa (PTA). Membership of these organizations is of importance when considering sub-regional co-operation in development of the fertilizer industrial system "FERTIS" in South-East Africa.

B. The Fertilizer Sub-sector in Tanzania.

Tanzania has one fertilizer manufacturer, the Tanzania Fertilizer Company (TFC), with a factory located at Tanga in the north-east of the country. It was incorporated in 1968 under the National Development Corporation as a joint venture between the Tanzanian Government and Klockner Ina. of West Germany, a general contractor responsible for the construction of the whole fertilizer complex. Details of the complex are presented in table 1.

Table 1

PLANT	CAPACITY	PROCESS	ENGINEERING
Sulphuric Acid	85.000 MTPY	Monsanto	Heurtey
Phosphoric Acid	66.000 MTPY	Pechiney St. Gobain	Spie-Batig-nolles.
Complex Fertilizer	45.000 MTPY	VKF	Continental Engineering
Ammonium Sulphate	20.000 MTPY	Standard Messo	St-rd Messo
Diammonium Phosphate	25.000 MTPY	VKF	Continental Engineering
Triple Superphosphate	25.000 MTPY	Pechiney St. Gobain	Spie-Batig-nolles.

TFC's fertilizer complex was commissioned in 1972, and began production on all imported raw materials (sulphur, phosphate rock, ammonia and potash). The initial production capacity amounted to 105,000 MTPY of product comprising of 20,000 MTPY of ammonium sulphate and 85,000 MTPY of granulated phosphate of different grades and low NPK compounds.

In 1978 the ammonium sulphate plant was replaced with a new plant having double the previous capacity, i.e. 40,000 MTPY. The new bulk-blending unit was installed in order to meet diversified demand for NPK's. At the same time, due to the rising cost of imported rock, own phosphate rock from the Minjingu deposit became an economically viable raw material and began to substitute for imported rock.

Many technical and technological changes have been introduced in the fertilizer complex at Tanga since it was commissioned. These changes have influenced the original production programme. The most important was the shutting down of the DAP (diammonium phosphate) plant due to technological difficulties. The production flow chart of the TFC Tanga complex is seen in annex 1.

Since commissioning, the nominal capacity of the Tanga Fertilizer Complex has increased from 105,000 MTPY to 125,000 MTPY. Production results are illustrated in table 2.

Table 2 Production of Fertilizers at the Tanga Fertilizer Complex (000s mt).

1972 -	13	1981 -	60
1973 -	30	1982 -	14
1974 -	59	1983 -	31
1975 -	59	1984 -	52
1976 -	42	1985 -	41
1977 -	37	1986 -	47
1978 -	44	1987 -	19
1979 -	46	1988 -	6 (planned for 26)
1980 -	51	1989 -	(planned for 47)

The planned figure for 1989 is unrealistic. As is seen in this table, capacity utilization has never reached 60% and was only 5% in 1988.

With a growing demand for fertilizers, imports (grants) of fertilizers increased, particularly in recent years, standing at 119,000 mt in 1987 and 137,000 mt in 1988 (as compared to 34,000 mt in 1973 and 64,000 mt in 1984).

Production at the TFC complex in Tanga has a marked impact on the fertilizer industrial system in the country. This is particularly so given that a second long-planned world-scale fertilizer nitrogen complex in Tanzania is not likely to get-off the ground in the near future.

C. FERTIS main components and linkages in Tanzania.

At the first level of the programme approach, the preparation of sectoral typologies, 43 African countries were grouped into 10 clusters of countries characterized by similar patterns of development of their FERTIS. Tanzania was located in country-group 1 along with the following eight countries; Burkina Faso, Ethiopia, Mali, Mozambique, Niger, Sudan, Tanzania and Zambia. This group was described as import substituting countries. This title is an apt description of Tanzania's position as Tanzania still tries to keep running the underexploited fertilizer complex in Tanga, and for many years has been trying to attract foreign capital in order to construct a new nitrogen fertilizer complex at Kilwa Masoko.

The development of each of the twelve components of the fertilizer industrial system identified in the sectoral typology exercise is described below for the Tanzanian case.

1. Natural resources

Tanzania is endowed with nitrogen and phosphorous related raw materials, namely natural gas, phosphate rock and apatite. Phosphate rock is used in the TFC fertilizer complex in Tanga. Apatite deposits are as yet unexploited. Both phosphatic raw materials require further surveys and exploration. This is of utmost importance for a decision on further exploitation of the Tanga fertilizer complex. Such a decision will also depend on reserves at the Minjingu phosphate mine, and the quality of beneficiated phosphate rock taking into account the high silica content of this rock.

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C. FERTIS main components and linkages in Tanzania.

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Natural gas has not yet been processed to ammonia. Ammonia is being imported to Tanga. No potash ores are reported. Sulphate of potash (SOP) is being imported to Tanga. At least partial substitution of SOP for much cheaper muriate of potash (MOP) is recommended.

Iron pyrites - carriers of sulphur - are reported to exist in Tanzania but have not yet been explored and sulphur demand for TFC Tanga is covered by imports.

Limestone and dolomite - carriers of the secondary nutrients calcium and magnesium - are exploited or reported in the northern and southern regions bordering Kenya and Zambia, as well as on the coastal region.

Micronutrients have not yet been properly surveyed, though copper and iron deposits exist. No boron bearing minerals or boron compounds are known to exist in Tanzania. Borax used at Tanga for the production of NPK-B is imported.

A relatively low level of development of the mining sector in Tanzania, hinders development of the domestic fertilizer industry. Work on surveying, exploration and exploitation of FERTIS related raw materials should be accelerated.

2. Processing to intermediary products: ammonia and phosphoric acid.

As mentioned above, natural gas has not yet been processed into ammonia in Tanzania, although there are good prospects for development of ammonia and nitrogen fertilizers.

Production of phosphoric acid (PA) in Tanga is based on own phosphate rock and sulphuric acid (SA) produced from imported sulphur. Both SA and PA plants are overexploited and characterized by low on-stream factors, low capacity utilization and obsolete processes. The SA plant should be replaced by a new one as it acts as a constraint to the whole complex. PA plant should be modernized and revamped.

3. Processing to NPK fertilizers

Processing to NPK fertilizers has been developed in Tanga on the basis of raw TSP and PK's derived from imported SOP (see Tanga's production flow chart). Nitrogen is introduced to PK's through imported urea (U) and ammonium nitrate (AN) to form different grades of NPK's. Production of NPK is characterized by a high degree of dependency on imported fertilizers (SOP, AN, U). Diammonium phosphate (DAP) is not produced in Tanga, though this plant has been commissioned with the whole complex, thus making it impossible to employ another route for the production of NP and NPK using cheaper MOP.

4. Granulation compounding and bulk blending

Granulation compounding and bulk blending have been developed in Tanga. However, the whole chain of processes and unit operations is relatively obsolete and labour intensive. Bagged fertilizers imported to Tanga are unbagged manually, mixed with other products and bagged again. Wastage of PE/PP bags is unavoidable. This section of the TFC complex requires modernization.

5. Total energy self-sufficiency and energy consumption per capita were used as a measure of industrial inputs and services. Energy consumption per capita, amounting to 35 kg of oil equivalent in 1986, is among the lowest in the world.

Tanzania is heavily dependent on imports of oil and oil products. Although working quite efficiently, the TIPER refinery at DSM cannot cope with growing domestic demand for oil and petrochemical products. Several companies are prospecting for on and offshore oilfields, but as yet these have met with no success. Crude oil is still being imported to the TIPER refinery as well as being pipelined from DSM to Zambia. As already mentioned, natural gas reserves (41 billion cubic metres) have been discovered at Songo-Songo island. A much larger field has been discovered at Kimbiji, this being the greatest enhancement for FERTIS development in Tanzania.

Total installed electricity generating capacity is currently about 440 megawatts, of which about 70% is hydro-electric. Development plans are concentrated on further utilization of the country's hydro-electric potential. The Kiwira coal mine in the south, built by the Chinese, has lately been commissioned with an initial production rate of 150,000 MTPY, to be raised eventually to 600,000 MTPY. This will strengthen the energy sector potential in Tanzania, as about 90% of energy requirements have been covered by biomass energy resources (fuelwood and charcoal). The rural population depends almost entirely on fuelwood, and this is now leading to serious deforestation. Only about 10% of energy requirements in Tanzania is met by petroleum, hydroelectricity and coal.

6. Storage, transport and distribution

Storage, transport and distribution, involving the whole chain of unloading, storing, handling and transport operations, is recognized to be one of the major bottlenecks hampering the development of FERTIS in Tanzania. Due to inefficiency of the fertilizer complex in Tanga most fertilizer demand is met by imports concentrated in the port at DSM. Lack of sufficient fertilizer storage capacity and necessary product handling facilities in DSM is the single most constraining factor on packing and shipping fertilizer to 19 regions in Tanzania. These regions are located at a distance from DSM ranging from 500 km to 1500 km. An adequate fertilizer storage/transport network capacity in DSM and in key agricultural regions is a sine qua non condition of a fertilizer consumption increase in Tanzania in the near future.

Though much work has already been done to establish seven fertilizer storage centers in the country (aside from the complex at Tanga), still the most difficult situation exists in DSM, and Songea and Makambako in the southern part of Tanzania. Fertilizer storage capacity at DSM is also of importance for other countries, particularly Zambia.

7. Consumption of NPK fertilizers

Consumption of NPK fertilizers amounted to almost 140,000 MTPY in 1986 and 1987, and dropped to about 115,000 MTPY in 1988. Sales planned for 1989-92 are around 140,000 - 165,000 MTPY of fertilizer product. If it were not for constraints of availability and

infrastructure, a potential consumption of about 180,000 MTPY of fertilizer product would be possible at the present time. Taking into account the N:P:K ratio of fertilizers used in Tanzania, which is approximately 1.00:0.42:0.08, this amount could be divided as follows: N - 43,000 MTPY, P2O5 - 18,000 MTPY, K2O - 3,000 MTPY and NPK - 64,000 MTPY.

Such a level of consumption indicates a substantial fertilizer domestic market, justifying, inter alia, consideration of rehabilitation and revamping of the fertilizer complex at Tanga. Such actions are further justified when future growth in demand for fertilizers is considered.

8. Demand for fertilizers by the year 2000,

Demand for fertilizers by the year 2000 and the corresponding NPK gap by 2000 have the greatest importance in the evaluation of FERTIS development in Africa. According to a UNIDO scenario, the NPK demand in Tanzania in the year 2000 has been forecast at 153,000 mt of pure nutrients, equivalent to about 385,000 of fertilizer products. This level of demand broadly corresponds with the demand forecast adopted in the National Fertilizer Policy Study prepared by Tanzanian and FAO specialists in May 1989.
Such a level of demand should, however, be treated as a low scenario in which demand for NPK has been set taking into consideration real constraints on future fertilizer consumption growth (availability of fertilizer, transport and distribution constraints, incentives to use fertilizers, etc.). The low scenario is a pragmatic approach in which cumulative constraints on fertilizer consumption growth have been included.

However, according to both the FAO Scenario A prepared in 1980 and the National Food Strategy, NPK demand in the year 2000 was estimated at 235,000 MTPY of pure nutrients (or about 650,000 MTPY of fertilizer product). The National Food Strategy target was recently confirmed by the Ministry of Agriculture. Such a demand should be treated as a high scenario, representing potential demand for fertilizers and assuming elimination of the major constraints on fertilizer consumption growth.

Under the most pessimistic conditions, with NPK demand 2000 in line with the High Scenario, the fertilizer complex at Tanga shut-down and the Kilwa-Masoko ammonia-urea project not implemented, the NPK gap 2000 in Tanzania could be as high as the potential demand (253,000 MTPY of pure nutrients).

This NPK gap best illustrates the importance of FERTIS development in Tanzania, and in particular raises questions related to two long-discussed projects, rehabilitation of the phosphate fertilizer complex in Tanga and construction of the new nitrogen fertilizer complex in Tanzania.

9. Fertilizer application in agriculture

Tanzania's fertilization rate of about 8 kg of NPK per

ha of arable land with permanent crops is below the mean African value of about 16 kg of NPK per ha. However, on this variable it is close to its neighbours in country-group I namely Burkina Faso, Ethiopia and Sudan.

The considerable hectarage of arable land is an enhancement for FERTIS development. However, a relatively low share of arable land in agricultural area, about 13%, is a constraint to FERTIS development as there is still potential for arable land increase.

With a population estimated by the World Bank at 37 million by 2000 (27 million by 1990) there will be growing pressure on land in Tanzania.

10. Fertilizer impact on agricultural production

Fertilizer impact on agricultural production is here described by the effectiveness of fertilizer use in terms of kg of cereals produced per kg of NPK used. As much as 8-17 kg of maize grain (maize is a major fertilizer consuming crop in Tanzania) were harvested after application of 1 kg of nutrient in trials in 1982-1987.

Yield increases on maize in response to nitrogen application varied from 35% to 170%, increases in response to P_2O_5 varied from 13% to 49%, and in response to NP applications the variation was from 40% to 169% depending on the region and NP application rate.

With a high projected population by the year 2000, and GDP per capita 2000 lower than the average, Tanzania will be able to supply only limited inputs from the national economy to the agricultural sector. However, a relatively high agricultural potential shows that there are possibilities of achieving self-sufficiency ratio of up to 99% in cereals by the year 2000, provided that the most important inputs such as improved seeds and fertilizers are available to farmers.

11. The incentive to use fertilizers by farmers

The incentive to use fertilizers by farmers, expressed as a crop price/fertilizer price index, is lower in country-group I than the average for Africa. The average crop price/fertilizer price ratio in the period of 1976 to 1984 showed an upward trend from 1.5 to 2.6. However, in June 1984 fertilizer subsidies were withdrawn and farmers were required to pay the full price for fertilizers. The crop/fertilizer price index for 1986 is therefore relatively low (below 1.5)

During the last three-year Economic Recovery Programme, Tanzania devalued the shilling by 89 percent. This devaluation has considerably reduced the use of modern inputs in agriculture.

In order to increase incentives for fertilizer use, fertilizer prices have again been subsidized in Tanzania. For instance, the selling price of urea at regional centres amounted to about 23% of the full cost of urea during 1988. This subsidy will be phased out over the next five years.

The decline in the prices of export commodities along with the inability to process and transport own export crops has meant that increased agricultural production was not fully reflected in export earnings. On the other hand, difficulties in crop transportation, processing and weaknesses in the marketing system have kept fixed prices very high while at the same time leaving farmers with large stocks of unsold crops.

12. Government priority in FERTIS development

Government priority in FERTIS development was described by five variables, import of NPK, export of NPK, export of nitrogen related raw materials, export of phosphorous related raw materials and government strategy in FERTIS. These variables indicate the following:

- Import (grants) of fertilizers dominate domestic production.
- Export of fertilizers, including nitrogen and phosphorous related raw materials, do not exist in Tanzania at the present.
- Government strategy is set primarily on import substitution (plans for rehabilitation of the TFC complex at Tanga and construction of the new nitrogen complex at Kilwa Masoko), but also on export promotion (plans for urea exports from the Kilwa Masoko complex).

1.2 Quantitative description of the performance of all important components of the fertilizer industrial system.

The Fertilizer Industrial System in Tanzania can best be described through presentation of the FERTIS base diagramme-Tanzania 1988 illustrating the performance of all main components of the system (see enclosure 3).

Due to the poor performance of the Tanga Fertilizer Complex which only operated during 2 months of 1988, the complex delivered only 4% of fertilizers consumed by the agricultural sector. The remaining supplies came from imports (grants) through the port of Dar es Salaam.

Distribution of fertilizers was realized from TFC regional stores through three channels, cooperatives (about 60%), state (about 10%) and private (about 30%). Regional fertilizer sales showed that as much as 75% of fertilizers were supplied to four regions, Iringa, Mbeya, Ruvuma and Tabora. The bulk of fertilizers, around 70%, was consumed by small scale farmers in the peasant sector.

Procurement and distribution of fertilizer is a task of the Tanzania Fertilizer Company Limited. Procurement is carried out through bidding although grants have dominated lately.

Priority in supply was given to CAN and urea followed by AS and TSP, as well as tobacco grade NPK. Altogether, about 50,000 mt of pure nutrients were delivered to the agricultural sector in 1988, with the resulting N:P:K ratio of 1:0.4:0.09. Sulphur, as a secondary nutrient, was supplied to the soil through ammonium sulphate (around 7,000 mt of

S). The only micronutrient, boron, was supplied with NPK fertilizer 6-20-18 for tobacco growers.

Demand for fertilizers in 1988, at around 180,000 mt, was covered by 80%.

Since over 95% of fertilizer supplied to agriculture came from imports (grants), it is considered illustrative to present the fertilizer price build-up on the example of urea imported to Tanzania during 1988 (prices in US$ per 1 mt of urea). Table 3 illustrates this price build up.

Table 3. Factors Contributing to the Farm Gate Price of Imported Urea (US $).

CIF price Dar es Salaam (DSM)	178.27
Local costs (wharfage, handling, stevedoring, transport to store, preshipment charges, etc.)	19.31
Total CIF and local costs in DSM	197.58
TFC overheads (5%)	9.88
Transport to regional stores	29.17
Distributor price at regional centres	236.63
Distributor trade margin (10%)	23.66
Retail price at regional centres	260.29
Retail price subsidy	(-186.05)
Selling price at regional centres	75.24
Distributor handling costs for sales at village level up to 300 km from the distributor's store (25%)	18.81
Farm gate urea price (US$ per 1 mt)	94.05

The farm gate urea price was around 50% of the CIF urea price at DSM. Were it not for the subsidy the whole chain of operations from the port of DSM to the farm gate would cause a build-up in price of about US$ 147 per mt of urea. This is a clear indication of the constraining influence of the inadequate infrastructure and transport network.

Table 4 illustrates the distribution of fertilizers through TFC's storage facilities.

Table 4. The Distribution of Fertilizers Through TFC's Storage Facilities

No. Region Supplied (Port-Rail-Road)	Location	Capacity (mt)
1. Coast (DSM) From imports through port of Ex-Tanga by Rail-road.	DSM	4,500 DSM and
2. Iringa Ex-DSM and Tanga by Road.	Iringa	7,000
	Makambako	10,000
Ex-DSM by Rail and Tanga-Road.		
3. Kilimanjaro Ex-Tanga by Rail-Road	Kahe (Moshi)	12,000
4. Morogoro Ex-DSM by Rail-Road and Tanga	Morogoro	4,000
5. Tanga	TFC Complex	17,000
	Tanga town	6,000
By Road from TFC Complex		
6. Mwanza Ex-DSM by Road and Morogoro by	Mwanza	5,000 Rail.
7. Tabora Ex-DSM and Tanga by Rail.	Tabora	20,000
8. Mtwara Ex-DSM by Road (or by sea).	Mtwara	4,000
9. Rukwa Ex-DSM by Rail and Road.	Sumbawanga	10,000
10. Ruvuma Ex-DSM by Rail and Road.	Songea	4,000
11. Mbeya Ex-DSM by Rail.	Mbozi	1,000

The majority of these fertilizer stores are rented and do not belong to the TFC. New proposals for fertilizer storage facilities in Tanzania include 20,000 mt at DSM, 10,000 mt at Songea and 10,000 mt at Makambako. The two latter projects remain to be completed (see attached Technical Assistance project proposals).

When new storage capacities are completed the total storage capacity will reach 144,000 mt of fertilizer products, provided that renting and co-owning of these stores by TFC does not meet with any difficulties.

1.3 Importance of the system in the Tanzanian economy

From interviews held at the Ministry of Agriculture, the offices of FAO in DSM and in TFC it appeared that fertilizers are considered the most critical input to attain agricultural production increases.

The order of priority of inputs constraining agricultural production increases in Tanzania has a distinct sequence. That sequence begins with fertilizer and is followed by seeds, pesticides, irrigation and agro-machinery in that order. For particular crops this sequence may vary. For instance for coffee the critical path would likely be fertilizers, pesticides, irrigation, agro-machinery and seeds. However, fertilizer is again the most constraining input.

As compared to FERTIS, a weak infrastructure and transport network in Tanzania is an even more constraining factor for agricultural development, as both supply of agricultural inputs and movement of agricultural products for export markets are limited.

Increased use of fertilizer is a key component in the National Food Strategy elaborated in 1984. The Government is committed to satisfying the fertilizer needs of small-holders as well as the needs of large-scale private and public sector farms. The special needs of cash-crop producers are also considered in the National Food Strategy.

It is assumed that artificial, inorganic fertilizers will have more positive results if used on soils with reliable structural properties and water content. Thus the use of organic fertilizers becomes very important as a soil improvement measure while implementing the food strategy programme. Mulching, use of animal manure and compost is emphasized, especially where soils have deteriorated.

FERTIS development must be accompanied by programmes aimed at expanding the cultivated area, introducing improved seeds, cultivation practices and irrigation as well as increasing the use of pesticides.

1.4 Government development objectives related to the FERTIS

The Government development objectives related to FERTIS are included in the National Food Strategy according to which the following targets were set for the year 2000:

A. An estimated daily calorie per capita intake of 2577 kcal.

B. A growth of consumption of major food items during 1980-2000 of 4.8% for rice, 3.4% for maize, 3.3% for millet, 3.3% for sorghum, 6.2% for wheat, 3.4% for cassava and 2.8% for bananas.

C. Production of major crops during 1980-2000 (in 000 mt) of the following magnitude:

	1980	2000	Average growth rate
Total cereals	3,108	6,917	4.3%
Cereals per capita (kg)		178	199
Total starches	3,939	7,079	3.0%
Starches per capita (kg)		217	203

Note: Population estimated at 18.2 and 34.8 million inhabitants in 1980 and 2000.

D. An effect of alternative production strategies on the net balance of major food items of the following magnitudes (in 000 mt):

	TRADE BALACE 2000		
	Scenario A	Scenario B	Scenario C
Total cereals	-1647	-1591	+506
Total starches	- 944	- 232	+218

Note: Scenario A involves only expansion of area (from 6.4 million ha in 1980 to 9.7 million ha in 2000). Fertilizer and water use is maintained at present levels. Scenario B involves area expansion and improved seed and cultivation practices. Fertilizer and water use is again maintained at present levels. Scenario C involves area expansion, provision of fertilizers and improved seeds as well as irrigation.

E. Projected fertilizer use by crops of the following magnitude (mt):

	1980	2000
Maize	44,203	349,830
Rice (paddy)	1,752	36,108
Sugar	7,342	39,000
Wheat	260	24,106
Cash Crops	45,664	176,060
Others	5,379	27,949
Total Crops	104,600	653,053

Maize and cash crops are the prime users of fertilizers, with small-holders accounting for nearly 75% of purchases. It was estimated that successful implementation of the National Food Strategy would require an increase in fertilizer use to about 650,000 mt in the year 2000, a level six times higher than that of 1980. It was assumed that of the total fertilizer requirement in the year 2000, maize would account for 54%, followed by cash crops at 27%.

F. Fertilizer consumption by region would be of the following magnitude (mt):

Region	1980	2000	Planned increase (%)
Shinyanga	2,607	39,528	1,516
Mwanza	2,923	34,495	1,180
Mara	1,158	20,563	1,775
Singida	484	4,448	919
Dodoma	356	2,262	635
Arusha	2,751	49,902	1,814
Kagera	1,104	38,043	3,446
Kilimanjaro	5,901	30,004	508
Lindi	166	7,259	4,535
Mtwara	428	6,268	1,465
Morogoro	4,653	72,420	1,556
Coast and DSM	1,704	12,487	733
Tanga	3,929	40,933	1,043
Tabora	12,234	38,127	312
Kigoma	1,661	13,848	834
Iringa	22,248	67,282	302
Mbeya	16,048	74,790	466
Rukwa	6,340	52,871	834
Ruvuma	17,675	48,512	275
TANZANIA	104,370	654,052	626%

According to the National Food Strategy, consumption of fertilizer was to increase from the 1980 level of 104,000 mt to 203,000 mt by 1985, 350,000 mt by 1990, and 650,000 mt by the year 2000. However, several constraints and delays came into play, and in the process consumption of fertilizers of 153,000 mt planned for 1990 will cover the National Food Strategy target by only 44%.

1.5 Ongoing development activities related to the system

The most important ongoing activities directly or indirectly related to FERTIS are described below:

Agriculture and Rural Development

1. IDA - US$ 18.4 million.

Existing extension services will be rehabilitated and consolidated so as to disseminate appropriate agricultural technologies to farmers, thereby enabling them to increase production and rural incomes. Co-financing (US$ 8.8 million) is anticipated from the Africa Development Fund (ADF). Total cost: US$ 30.4 million

2. IDA - US$ 8.3 million.

The first stage in the long-term process of rehabilitating the country's agricultural research system will be implemented. A consolidated and streamlined organizational structure and management system for research will be put in place, staff will be trained,

institution-building assistance will be provided, some priority programmes rehabilitated and a research master plan prepared. Co-financing is expected from the African Development Fund (US$ 8.2 million), the United Kingdom (US$ 2.9 million), the Netherlands (US$ 2.7 million), and the Federal Republic of Germany (US$ 1.6 million). Total cost: US$ 25.3 million

3. IDA-US$ 158.6 million agricultural adjustment-pricing and institutional reform in agriculture. An appraisal report is under preparation.

Ports and Transportation

1. IDA-US$ 146 million. Roads I-Rehabilitation programme. An appraisal report is being prepared.

2. IDA-US$ 30 million. Ports modernization

To assist Tanzania in optimizing port handling capacity by rehabilitating/improving terminal facilities at Tanga and Dar es Salaam, increasing productivity and improving maintenance capability through technical assistance, training and provision of spare parts for equipment rehabilitation. An appraisal report is under preparation.

Other Ongoing Activities

1. IDA-US$ 135 million.

The broadening of the Government's recovery programme will be supported through reform in the trade regime and initiation of the restructuring and rehabilitation of the industrial sector. Co-financing is expected from the African Development Fund (US$ 24 million), the United Kingdom (US$ 15 million), Switzerland (US$ 14 million) and the Netherlands (US$ 10 million).

Apart from the above mentioned activities sponsored by International Organizations and Donor Countries, Tanzania is seeking finance for the following projects (see also the relevant technical assistance projects in part B of this study):

(a) Construction and completion of the fertilizer stores in DSM, Songea and Makambako supervised by the Tanzania Fertilizer Company Limited (TFC).
(b) Revamping the Tanga Fertilizer Complex.
(c) Realization of the world-scale export-oriented ammonia-urea fertilizer complex at Kilwa Masoko supervised by Kilwa Ammonia Co. (Kilamco) and Tanzania Petroleum Development Corporation.

These projects aim at increasing the flexibility of fertilizer distribution in the country, lessening the dependency on fertilizer imports (grants) and at developing long term scenarios of fertilizer import substitution and export promotion. The availability of foreign exchange is the single most important constraint in implementing these projects.

1.6 Institutional framework for the development of the system

The National Food Strategy was a milestone in defining objectives for the development of the Fertilizer Industrial System in Tanzania. The country's agricultural policy laid emphasis on increased domestic food production as a consequence of both area expansion and increased yields per hectare through intensified use of fertilizers. The objective here was to improve the nutritional standards of the population and progressively move the country towards food self-sufficiency.

In spite of the country's high agricultural potential, most of the objectives set in the National Food Strategy have not been reached by 1990. FERTIS development targets have also not been attained.

The growing crisis in the Tanzanian economy induced the Government to adopt wide-ranging Structural Adjustment Programmes, under which a growth in the institutional infrastructure supporting Tanzanian industry has been envisaged. A number of institutions have been set up to support manufacturing in the fields of industrial promotion, consultancy, training, research, development and finance. Such institutions include entities such as the Tanzanian Investment Bank within the Ministry of Industry intended to identify foreign exchange priorities.

The deteriorating international situation has prevented an improvement of industrial performance and an adequate utilization of the natural resource base for restructuring and development of Tanzanian industry.

An agreement was undertaken with the IMF in August 1986. The June 1986 budget entailed significant policy changes while the Government took important steps towards meeting the IMF's recommendations. After the agreement with the IMF an 18 month stand-by arrangement of US$ 77.5 million was made, followed by a World Bank contribution of US$ 96 million to support a three year economic recovery programme (ERP) to August 1989.

Further World Bank sectoral loans have been disbursed. Tanzania was one of the first beneficiaries of the World Bank Special Africa Facility. The agreement with the IMF enabled Tanzania to negotiate significant additional aid inflows from bilateral donors.

Tanzania receives a substantial amount of fertilizer grants from a number of countries such as the Netherlands, Sweden, Norway and Japan, international organizations such as NORAD, SIDA, FAO as well as the International Fertilizer Scheme.

The TFC Fertilizer Complex was not given priority in the economic recovery programme, and substantial grants of fertilizer have postponed a decision on revamping the complex

Tanzania's membership in regional organizations such as SADCC, PTA and the Kagera Basin Organization is one of the principal justifications for construction of the Kilwa Masoko fertilizer complex, permiting economies of scale and exports of ammonia-urea surpluses to neighbouring countries under sub-regional investment and trade agreements.

2. PROGRAMME JUSTIFICATION

2.1 Problems to be addressed: Bottlenecks and Constraints Hindering Development of the System Towards the Government Objectives

According to FAO Scenario A-1980 and the National Food Strategy, NPK demand in the year 2000 should be estimated at about 235,000 mt of pure nutrients, corresponding to about 650,000 mt of fertilizer products.

Taking into account substantial delays in achieving the National Food Strategy targets by 1990 (where fertilizer consumption planned at 153,000 mt covers only 44% of the target of 350,000 mt), it is assumed that a high scenario of consumption of 650,000 mt of fertilizer by 2000 is somewhat unrealistic.

The UNIDO scenario-1983, which broadly corresponds to the demand forecast adopted in the National Fertilizer Policy Study of May 1989, is seen as much more appropriate to the real constraints in FERTIS development. Thus, the low scenario (153,000 mt of NPK, equivalent to about 385,000 mt of product) has been taken as a basis for designing FERTIS development strategies up to the year 2000.

The following five constraints are believed to be the most important in not having attained the objectives planned in the National Food Strategy:

1. Deterioration of the TFC Fertilizer Complex at Tanga.

2. Substantial delays in launching the Kilwa Masoko fertilizer project, planned since the early 1980s.

3. A relatively poorly developed infrastructure and transport network, constraining distribution of fertilizers from poor fertilizer storage facilities having insufficient capacities.

4. Insufficiently developed FERTIS raw material base.

5. The availability of foreign exchange which influences directly or indirectly all the above mentioned constraints, affecting simultaneously several FERTIS components.

The availability of foreign exchange and the possibility of attracting foreign capital for fertilizer projects in Tanga and Kilwa Masoko is the most important constraint limiting progress in Government strategies related to FERTIS development. The country is thus almost totally dependent on grants in fertilizers.

The Government objective of rehabilitating the TFC complex at Tanga and of establishing a new fertilizer complex at Kilwa Masoko are constrained in a different way. Rehabilitation of the Tanga complex involves simultaneous investment in different plants, general facilities in the complex and facilities of the Minjingu Phosphate Mine and Tanga port.

Rehabilitation of the Tanga complex calls for a high level technical expertise, experienced contracting and skillful organization of the whole programme in order to assure that the relatively obsolete installations will be modernized in the shortest possible time.

One of the most important potential bottlenecks that may hinder rehabilitation of the Tanga complex is the availability of phosphate rock for future production of fertilizers. At least 100,000 MTPY of phosphate rock concentrate of 30% P_2O_5 is necessary in order to continue efficient production at Tanga.

In their report of August 1988 entitled "Macro and Micro Economic Study on the Minjingu Phosphate Company Ltd.", CSM Consulting of Finland and IFDC of the United States raised serious doubts on the availability of phosphate rock concentrate from the Minjingu deposits to enable operation of the fertilizer complex beyond the next ten years.

According to the conclusions of the study, promoted by FINNIDA, only about 300,000 mt of soft rock concentrate could be produced from Minjingu Phosphate Mine utilizing the existing phosphate rock beneficiation plant.

The study also reports that other soft phosphate rock reserves in the area may not be easily accessible. About half of the total deposit, estimated at some 10 million tonnes, is a hard phosphate rock that could not be beneficiated efficiently in the existing plant to yield 30% P_2O_5 concentrate.

Such conclusions may place in doubt any idea of rehabilitating the fertilizer complex at Tanga, production of which is based virtually only on local raw material-phosphate rock.

These conclusions are, however, not shared by the State Mining Company (STAMICO) responsible for development of mineral resources in Tanzania. STAMICO is of the opinion that the necessary quantities of 100,000 MTPY of phosphate concentrate can be delivered from the Minjingu deposit on a long-term basis.

The Commissioner for Minerals in the Ministry of Energy and Mines, in an interview with the author, confirmed that several drillings made lately indicated new soft phosphate reserves and that there should be no doubt as regards Minjingu Phosphate Mine being able to supply TFC Tanga with sufficient quantities of phosphate rock concentrate.

The availability of phosphate rock for the fertilizer complex at Tanga is seen as the most important problem to be addressed in the FERTIS Integrated Development Programme in Tanzania and should be clarified before any investment actions related to rehabilitation of the complex are undertaken (see the technical assistance project proposal related to STAMICO and the implementation schedule of the technical assistance projects).

Problems related to the Government plans on the Kilwa Masoko project are of a different nature. For the ammonia-urea export-oriented and sea-side located fertilizer complex to be competitive in international markets, some important criteria must be met, as follows:

- To reap economies of scale the complex should be of world-scale capacity. This, in turn, necessitates huge capital investment for the construction of ammonia-urea plants.

- Cheap sulphur-free natural gas must be available and the local raw material base should be developed. This is only partly the case with the Kilwa Masoko project. However, no natural gas network, nor natural gas utilization schemes have been developed in Tanzania. This will tend to increase investment costs for the whole project.

- Sources of investment finance, including foreign exchange, must be readily available in order to smoothly construct the complex without delays. This is not the case with the Kilwa Masoko project. KILAMCO has been seeking finance from government agencies in Japan, Belgium, West Germany, the United Kingdom and Italy.

- The complex should operate at a high capacity utilization level in order to keep ammonia-urea manufacturing costs low and not to loose competitiveness on international markets. This calls for a special programme of manpower development, staff and management training, and institutional capacity building at KILAMCO and the Tanzania Petroleum Development Corporation.

- There should be sufficient market to absorb products from the complex. However, the urea market in Tanzania is not large enough to justify planning a world-scale capacity ammonia-urea complex. Export markets should be assured before allocating investment for a world-scale fertilizer complex. According to Government plans the complex is to have a capacity of 515,000 MTPY of ammonia and 570,000 MTPY of urea. Urea is aimed mainly at export markets inside and outside of Africa. The urea price from Kilwa Masoko should thus be internationally competitive.

Government plans for the Kilwa Masoko project to be oriented for exports outside Africa are considered in this study to be unrealistic, all the more so because the complex is to be built where infrastructure is lacking. This means that the investment location factor at Kilwa Masoko will be higher than that at other locations such as in the Persian Gulf where natural gas is currently flared.

2.2 Analysis of alternative development strategies

As total dependency on fertilizer grants cannot be accepted in a long-term strategy of FERTIS development in Tanzania, and since important constraints hinder development of the system in line with Government objectives, alternative development strategies concerning projects at Tanga and Kilwa Masoko should be examined.

TFC Fertilizer Complex at Tanga

The Government objective of rehabilitating fertilizer plants at Tanga (see the technical assistance project prepared by the National Chemical Industries) are correctly oriented. However, rehabilitation of the complex with only limited modernization would not change the overall efficiency of production and might thus jeapordize the project's viability and competitiveness.

Investment actions aim simultaneously at rehabilitation, and modernization of individual plants, as well as at the revamping of the whole complex with the diversification of its production programme. This idea is best illustrated in enclosure 4, which presents the TFC Tanga production flow chart and the most important production targets. These targets have been described in a more quantitative manner in enclosure 5, the FERTIS base diagramme (Time Base 2000), and in the FERTIS Scenario 2000 (with TFC Tanga operational) shown in enclosure 7.

When formulating a revamping programme for TFC Tanga, it is of utmost importance to properly coordinate priority actions aiming at:

- defining mineable proven reserves of phosphate rock in the Minjingu phosphate deposit (see the attached technical assistance project proposal);

- selecting the most suitable phosphate rock beneficiation technologies. The high silica content of the phosphate rock should be taken into consideration;

- assuring continuous flow of phosphate rock concentrate from Minjingu Mine to TFC Tanga. As much as 135,000 MTPY of phosphate rock concentrate is needed to cover the needs of the revamped fertilizer complex.

An alternative arrangement of the Kilwa Masoko fertilizer complex might have as its aim to supplement ammonia-urea plants with a nitrophosphate plant based on imported phosphate rock.

Any scenario in which revamping of TFC Tanga is envisaged should be backed by a reliable system of phosphate rock delivery, preferably from domestic sources. Of great importance in revamping TFC Tanga is improvement of the performance of the port of Tanga (see section 1.5 above) in order to assure smooth unloading of raw materials, intermediaries and fertilizer products to be delivered to TFC Tanga either from Kilwa Masoko or from imports.

Kilwa Masoko Fertilizer Complex

An alternative strategy for the Kilwa Masoko project would be to market ammonia and urea on the African continent. This may be the only possibility for the Kilwa Masoko complex to compete with imported ammonia and urea. Kilwa Masoko's competitivity would be strengthened on account of the cost of transport and insurance from the world market to the East African coast. This transport cost is estimated to add US$

30-40 for every metric tonne of ammonia and urea, depending on the source of delivery, the size of shipment and other conditions.

This strategy is best illustrated in enclosure 8, showing ammonia and urea flows to TFC Tanga and to neighbouring countries, as well as in enclosures 5, 6 and 7 showing linkages among the plants and their capacities.

As much as 200,000 MTPY of ammonia could be exported from Kilwa Masoko and delivered by sea and rail to Tanzania's neighbours, while some 170,000 MTPY of urea could be delivered by sea, rail and road.

This strategy assumes sub-regional cooperation among South East African countries. In order to make this strategy workable, there is a need to reach agreements at the sub-regional level regarding cooperation on investing in the Kilwa Masoko complex as well as interest in future supplies of ammonia and urea from this complex. An important role in such agreements could be seen for the Southern African Development Coordination Conference (SADCC), the Preferential Trade Area for East and Southern Africa (PTA) and the Kagera Basin Organization (KBO) (see also the technical assistance project proposal, regarding an investment promotion conference in Tanzania on FERTIS development in the region).

2.3 Quantitative analysis of various options for overcoming bottlenecks and constraints

Given the present deterioration of the Tanga complex and the uncertain economic and financial viability of the revamping programme, it was considered more appropriate to analyze two mutually exclusive options. These options included programmes both with and without the TFC Tanga complex in operation, though the idea of revamping the Tanga complex is strongly recommended in this study.

A revamped fertilizer complex at Tanga is included in one option. The Kilwa Masoko fertilizer complex appears in both options, although with different production programmes.

Both FERTIS development scenarios designed in this study (see enclosures 5, 6 and 7) aim at meeting the target of supplying Tanzanian agriculture with NPK nutrients at a level slightly above the low NPK demand scenario 2000 of 153,000 MTPY of NPK. This level of demand is reckoned to be more realistic than the high demand scenario, set at as much as 235,000 MTPY of NPK in line with National Food Strategy targets.

The FERTIS scenario 2000 with the Tanga complex in operation aims at supplying agriculture with 165,000 MTPY of NPK, enabling a fertilization rate of 24 kg NPK per hectare of cultivated area. This scenario assumes efficient operation of the Tanga complex after its revamping, rehabilitation of TFC facilities in the sea harbour at Tanga, and revamping of the Minjingu Phosphate Mine with a phosphate rock beneficiation plant.

A nitrophosphates plant, to supplement ammonia-urea plants at the Kilwa Masoko fertilizer complex, is envisaged for the following reasons:

- The nitrophosphate process is a sulphur-free route for manufacturing NP 23-23-0 fertilizers which is of importance given that Tanzania is not endowed with sulphur deposits. A nitric acid plant will be the source of acid to attack phosphate rock.

- The NP plant with a capacity of 220 TPD would use imported phosphate rock. It is assumed that the Minjingu Phosphate Mine would not be able to fully supply the demand for phosphate rock, estimated in this scenario at about 185,000 MTPY of 30-33% P_2O_5 concentrate.

In addition to supplying Tanzanian agriculture with 165,000 MTPY of NPK and 11,000 MTPY of sulphur (equivalent to 390,000 MTPY of fertilizer products), it would be possible to export from Kilwa Masoko 200,000 MTPY of ammonia and 170,000 MTPY of urea destined for neighbouring countries.

The FERTIS scenario 2000 with Tanga out of operation assumes that the diagnosis on the viability of revamping TFC Tanga is negative and that the complex would have to be closed. In such case, an NPK bulk blending plant with adjacent fertilizer stores would be worth saving, even if it were to be operated on the basis of fertilizers produced at Kilwa Masoko and/or imported. The Minjingu Phosphate Mine also would have to be closed.

In this case, the configuration of Kilwa Masoko's production chart would have to be changed from nitrophosphates to diammonium phosphate (DAP) (fed with own ammonia and imported phosphoric acid) and to the NPK complex fertilizer plant (fed with own ammonia and urea, imported phosphoric acid and muriate of potash). A calcium ammonium nitrate (CAN) plant would be added along with the nitric acid (NA) plant.??? Sulphur would be delivered to agriculture through imports of 40,000 MTPY of ammonium sulphate, a relatively cheap fertilizer produced in world markets as a by-product of caprolactam and acrylonitryle processes.

The fertilization rate in this scenario would amount to 25 kg NPK per hectare of cultivated area.

Apart from supplying Tanzanian agriculture with 175,000 MTPY of NPK and 11,000 MTPY of sulphur, some 200,000 MTPY of ammonia and 170,000 MTPY of urea could be exported to neighbouring countries from Kilwa Masoko.

2.4 Evaluation and selection of preferred strategy

When comparing the two FERTIS development scenarios in Tanzania, namely the with and without TFC Tanga scenarios, the first option is preferred. This option is better suited to the import substitution strategy adopted by the Government and affords several additional advantages, such as:

-Greater diversification of the fertilizer production programme, which permits the more comprehensive supply of domestic agriculture.

-The flexibility of fertilizer supply and distribution from two complexes (Tanga and Kilwa Masoko) is better than from only one complex (Kilwa Masoko).

-Production of fertilizers in this scenario is based on two local raw materials, natural gas and phosphate rock, as compared with only one (natural gas) in the alternative scenario.

-Foreign exchange expenditures for imports of raw materials, intermediary products and fertilizers are lower in the scenario with TFC Tanga in operation. In addition, foreign exchange savings, analyzed in the long-term are expected to be much higher in this scenario, as it allows for quicker realization of the import substitution strategy.

More detailed comparison of the two analyzed scenarios is presented in table 5.

Table 5. Comparison of Two Strategies for the Integrated Development of the Fertilizer Industrial System in Tanzania

FEATURES	SCENARIO WITH TFC TANGA	SCENARIO WITHOUT TFC TANGA
Fertilizer Plants	Tanga: SA, PA, TSP DAP, NPK, AS	Tanga: NPK
Kilwa Masoko:	A, U, NA, NP	K.M.: A, U, DAP, NPK, NA, CAN
Indicative Investment	Tanga: $ 80 million K.M.: $ 570 million Total: $ 650 million	Tanga: $ 10 million K.M.: $ 640 million Total: $ 650 million
Ammonia and urea export	200,000 MTPY + 170,000 MTPY	200,000 MTPY + 170,000 MTPY
NPK supply	165,000 MTPY	175,000 MTPY
Own NPKS supply	176,000 MTPY	167,000 MTPY
Total NPKS supply	176,000 MTPY	186,000 MTPY
Import of raw materials, intermediaries and fertilizers	S: 50,000 MTPY P.R.: 50,000 MTPY MOP: 17,000 MTPY	PA: 62,000 MTPY of P_2O_5 AS: 40,000 MTPY MOP: 17,000 MTPY
Realization schedule and production build-up	Tanga: 1990-93 K.M.: 1992-98	K.M.: 1992-98
NPK import substitution by the year 2000	Approx. 680,000 mt	Approx. 420,000 mt
Yearly foreign exchange expenditure in the year 2000	Max. $ 15 million	Min. $ 27 million
Export earnings in the year 2000	Min. $ 55 million	Min. $ 55 million

Note: Approximate prices prevailing in 1989 were used for estimations.

Given similar own supplies of NPK (NPKS), identical export capabilities and similar capital investment costs in both scenarios, the most substantial difference in favour of the scenario with TFC Tanga in operation is connected to import substitution of fertilizers of about 260,000 mt of pure nutrients, having a value of approximately US$ 80 million by 2000. A minimum yearly foreign exchange saving of approximately US$ 12 million should result from this scenario even if the Minjingu Phosphate Mine could not deliver 100,000 mt per year of phosphate rock concentrate.??? as compared to ????

2.5 Expected end-of-programme situation

After the preferred strategy, with TFC Tanga in operation, is implemented the expected end-of-programme situation will be as follows:

(a) Two fertilizer complexes will be operational in Tanzania by 2000, namely TFC Tanga and Kilwa Masoko.

(b) Tanzania will be virtually self-sufficient in fertilizer supply. No grants or imports of fertilizer will be needed, apart from possible minor imports of components not available in Tanzania, such as sulphur, potash and some microelements.

(c) Tanzania will become a net exporter of some 200,000 MTPY of ammonia and 170,000 MTPY of urea.

(d) A substantial build-up of fertilizer capacities is envisaged in South-East Africa based on ammonia and urea delivered from Kilwa Masoko. Almost the whole region of East and Southern Africa will benefit from FERTIS development in Tanzania, and the degree of dependency on fertilizer imports may be substantially lessened in those sub-regions.

(e) A significant transport, storage and distribution network of liquid ammonia and urea will be created in the region, providing support to possible sub-regional co-operation in the fertilizer industry. Kenya, Mozambique and Malawi will have an opportunity to build ammonia stores in the Mombasa, Beira and Blantyre area. Zimbabwe and Zambia would use their present ammonia storage capacity. Kenya may build its own DAP plant in the Mombasa area. Mozambique and Malawi may build their own NA-AN-CAN small-scale nitrogen complexes in the Beira and Blantyre area. Zimbabwe may intensify its AN production from the Que Que plant. Zambia may intensify the production of AN and AS from its Kafue plants. Kenya, Uganda, Rwanda, Burundi, Zambia, Malawi, Mozambique and Swaziland may use urea supplied from the Kilwa Masoko plant either as a straight nitrogen fertilizer or as a component in expanding production of bulk blended fertilizers.

(f) Tanzania will optimize its own fertilizer use in agriculture, deliveries of ammonia and urea from Kilwa Masoko to Tanga, phosphate rock from the Minjingu Phosphate Mine and from imports to Tanga and Kilwa Masoko, and - with its exports of ammonia and urea to the neighbouring countries - shall repay the investment credits taken up for the establishment of the Kilwa Masoko complex to its shareholders. Regional and possibly international organizations and bilateral donors will help in repayment of investment credits undertaken for the construction of a regional fertilizer complex at Kilwa Masoko.

2.6 Target Beneficiaries

The direct beneficiaries of the development programme will be Tanzanian farmers who will enjoy greater access to an appropriate range of fertilizers and thus be in a better position to increase crop yields. Benefits should thus also accrue to the nation as a whole through the greater availability of foodstuffs. National benefits also include an enhanced capacity to earn foreign exchange through the export of cash crops and ammonia/urea as well as a saving of foreign exchange through fertilizer import substitution. Farmers in neighbouring countries may also be included as beneficiaries contingent on the success of regional co-operation in this programme.

2.7. Reasons for Assistance from UNIDO/UNDP

The implementation of this programme requires assistance of a technical and policy nature as well as with regard to investments that is beyond the scope of Tanzania's accumulated industrial skills, experience and present financial capabilities.

2.8. Special Considerations

The implementation of this programme will involve economic co-operation among developing countries of this African sub-region. The potential environmental consequences of the programme will be monitored as follows..... ?

3. INTEGRATED DEVELOPMENT PROGRAMME

3.1 Programme objectives

The indicative programme for the integrated development of the fertilizer industrial system in Tanzania aims at:

- Strengthening Government capability in planning and co-ordination of development in the fertilizer industry. Capabilities neighbouring country governments and regional organizations will be strengthened in this sphere.

- Assisting in the formulation of Government strategies related to the development of FERTIS in Tanzania and in neighbouring countries.

- Defining long-term objectives and alternative development scenarios in order to accelerate national and sub-regional actions in planning and investing in the fertilizer industry.

- Assisting the Tanzania Fertilizer Company Ltd. to establish fertilizer stores in DSM, Songea and Makambako.

- Assisting the National Chemical Industries and the Tanzania Fertilizer Company Ltd. in revamping the TFC fertilizer complex at Tanga.

- Strengthening the capabilities of STAMICO in surveying and exploration of FERTIS related raw materials, especially as far as Minjingu phosphate reserves and phosphate rock beneficiation technologies are concerned.

- Assisting the Tanzania Petroleum Corporation and KILAMCO in formulating objectives for the establishment of the Kilwa Masoko fertilizer complex, and in attracting capital for the realization of this project on a regional basis.

- Assisting the Ministry of Agriculture, FAO in DSM and the National Soil Institute in Mlingano-Tanga to define optimum patterns of fertilizer application in Tanzania, while taking into consideration production programmes designed for Tanga and Kilwa Masoko.

- Helping the Tanzanian Government to attract foreign capital in order to create a national fertilizer industry able to substitute imports and promote exports of fertilizers. This objective will be facilitated by the planned investment promotion conference with international agencies, donors, regional organizations and countries neighbouring Tanzania.

The overall programme objectives can also be seen through comparison of investment and technical assistance actions between FERTIS country group I and Tanzania.

The Integrated Development Programme is illustrated in table 6.

Table 6 Integrated Development Programme for the Tanzanian Fertilizer Industrial System Adopting a Strategy With the TFC Tanga Complex in Operation.

Component	Technical Assistance*	Investments**	Policies
1.	Feasibility Study on Expansion of Production at the Minjingu Phosphate Mine (3.1). Cost - US$ 3,000,000	Potential investment, cost not estimated.	Policies relating to: -import substitution & export promotion of fertilizers -investment issues
1.	Feasibility Study on Opening Panda Hill Carbonite Mine (3.2) Cost - US$ 500,000	Potential investment, cost not estimated.	-regional co-operation in investment & trade related to fertilizer
1.	Feasibility Study on Apatite Production at Sangu Ikola Carbonatite (3.3). Cost - US$ 325,000	Potential investment, cost not estimated.	-national,sub-regional policies in mining, energy,transport, industry and agriculture.
1.	Feasibility Study on Exploitation of Sulphur Deposit and Recovery of Gold as a By-Product at the Samena Pyrite Mine (3.4). Cost US$ - 2,000,000	Potential investment, cost not estimated.	The above issues will be assessed in a project on policies to support the integrated development programme, including application of MEPS model to quantitatively assess alternative strategy options.
2. 3. 4.	Feasibility Study on Rehabilitation and Diversification of Production at Tanga Complex (1) Cost - US$ 300,000	Rehabilitation /Diversification of Tanga Complex Cost - US$ 80,000,000	
2. 3.	Techno-Economic Appraisal of a Diversified Production Programme at Kilwa-Masoko (4) Cost - US$ 150,000	Placing Kilwa Masoko Complex in operation Cost - US$ 57,000,000	
2. 3.	Investment Promotion Conference Cost - US$ 50,000 (6)		
6.	Completion of Fertilizers Warehouse (2a & 2b) Cost - US$ 50,000		
8.	Research on Appropriate Fertilizer Application in Tanzania (5) Cost - US$ 1,000,000		
	TOTAL - US$ 7,375,000	TOTAL - US$ 650,000,000	

* Numbers in brackets refer to the project number.

** These investments depend on positive results from the relevant feasibility studies.

Table 7. Components, Development Constraints, Ongoing Activities and Projects Aimed at Ameliorating Constraints in the Tanzanian Fertilizer Industrial System

Component	Description	Constraint	Ongoing Projects	Programme Projects
1.Natural resources	-Natural gas (Kilwa Masoko)	Unexploited		
	-Phosphate rock (Minjingu mine)	Possible under-exploitation		Feasibility study on Minjingu mine (3.1).
	-Apatite	Unexploited		Feasibility study Panda Hill Carbonatite (3.2) Techno-economic assmnt. Sangu-Ikola Mine (3.3)
	-Iron pyrites	Unexploited		Techno-economic assmnt. Samena Pyrite Mine (3.4)
	-Limestone and dolomite	Underexploited		
	-Micronutrients (copper and iron)	Not properly surveyed		
2.Intermediary Products.	Tanga complex: -Phosphoric acid based on own phosphate rock and imported sulphuric acid. -Ammonium sulphate plant since 1978.	Low capacity utilisation. Obsolete equipment Phosphoric acid plant needs rehabilitation and modernization.		-Rehabilitation of Tanga complex (1) -New ammonia-urea complex at Kilwa Masoko (4) -Investment promotion conference (6).
3.Processing NPK and TSP.	NPK derived from imported SOP, Urea and ammonia.	Low capacity utilisation. High degree of dependency on imported fertilizers. Diammonium phosphate no longer produced. Cannot use muriate of potash as raw material (it is cheaper than SOP).		-Rehabilitation of Tanga complex (1). -New ammonia-urea complex at Kilwa-Masoko (4) -Investment promotion conference (6).

3.2 Policy measures

In order to facilitate the implementation of the FERTIS development strategy in Tanzania and in the region of East-Southern Africa, appropriate policy measures should be undertaken, such as:

(a) Policies related to import substitution and export promotion in the fertilizer industrial sytem.

(b) Investment related policy issues, including technology transfer and development, contracting and equipment procurement, investment financing, manpower training.

(c) Policies aiming at strengthening co-operation among East-Southern African countries in the fertilizer industrial systems, in particular as far as investment in the fertilizer industry and trade with fertilizer raw materials, intermediaries and finished products are concerned. Also, policies aiming at strengthening co-operation of East-Southern African countries and their regional organizations with international organizations should be adopted in the course of implementation of the integrated development of the FERTIS in Tanzania and countries neighbouring Tanzania.

(d) National and sub-regional policies in agriculture, industry, mining, energy and transport - in order to assure balanced FERTIS development, harmonized with the development of the Tanzanian and regional economies.

(e) Policies aiming at the co-ordination of food and nutrition priority programmes with industrial programmes related to the development of the fertilizer industries in Tanzania and in the region of East-Southern Africa. Also, fertilizer and crop pricing policies need to be analysed at the level of regional organizations: SADCC, PTA, KBO and at the national levels.

It is suggested that a project be undertaken the goal of which would be to assess and suggest the most appropriate set of policies to support the integrated development programme. The project should make use of UNIDO's MEPS industrial simulation model with a view to quantitatively assessing the economic effects of alternative policy options and technologies.

3.3 Technical assistance and investment projects

The list of technical assistance/investment projects presented below includes six projects, five of which are directly or indirectly connected with potential investment actions.

The time schedule for implementation of the technical assistance programme in Tanzania, presented below, is estimated at 48 months. Table 8 illustrates the temporal position of each project in that schedule. There exists a logical and technical order of priority in these projects which is important to follow given the limited resources of the Tanzanian counterparts. All activity related to the rehabilitation of Tanga depends, for instance, on the availability of raw materials of sufficiently high quality and particularly phase I of the feasibility study connected with appraisal of the Minjingu phosphate deposit and phosphate rock beneficiation

technology. The immediate bottleneck related to inadequate storage capacity might be addressed in the short term, permitting a qualititative improvement in the operation of the system without incurring the major expenditures related to feasibility studies and investment. Research on the appropriate application of fertilizers might also receive a more immediate priority as the findings of this investigation would be instrumental both in shaping plans for future fertilizer production as well as rationalizing current imports of fertilizer. Feasibility work related to the Tanga complex may be given priority over similar work at Kilwa Masoko. This is because the former complex is already in operation and the risks associated with the establishment of a new complex may be relatively higher.

Apart from techno-economic appraisal, this schedule does not include an investment and realization schedule for the Kilwa Masoko fertilizer complex. This project realization schedule is presented in table 9. The time schedule for implementation of the technical assistance programme in Tanzania does not include all the actions to be taken by neighbouring countries in relation to the Kilwa Masoko project.

Table 8 Time Schedule for Technical Assistance Projects of the Integrated Development Programme for the Fertilizer Industrial System in Tanzania

No.	Technical Assistance Project	Years and Quarters: 1990 I	II	III	IV	1991 I	II	III	IV	1992 I	II	III	IV	1993 I	II	III	IV	1994 I	II	III	IV
1.	Feasibility study on rehabilitation and diversification of production at the Tanga complex.	———	- - - - -	———	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	———	———	———	———				
2.	Completion of fertilizers warehouse.	———	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -								
3.	Feasibility studies on raw material deposits at Minjingu phosphate mine, Panda Hill Carbonite mine, Sangu Ikola Carbonatite and the Samena Pyrite mine.	———	- - - - -	———	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	———	- - - - -						
4.	Techno-economic appraisal of a diversified production programme at Kilwa-Masoko.			———	- - - - -																
5.	Research on appropriate fertilizer application in Tanzania.	———	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -								
6.	Investment Promotion Conference.			- - - -	———																
7.	Appropriate Policy Analysis																				

Note: a dotted line denotes indirect UNIDO participation, a continuous line denotes direct UNIDO participation.

Table 9 Kilwa Masoko Fertilizer Project Realization Schedule

1991	1992	1993	1994	1995	1996	1997	1998
FEASIBILITY STUDY COMPLETE, COMMERCIAL DEVELOPMENT (form joint ventures, negotiate sales)	PROJECT PLANNING (select contractor, negotiate finance)						
	(MANAGING CONTRACTOR)						
		ENGINEERING DESIGN (Ammonia,Urea,NA,NP plants, gas utilities,offsites,port facilities)					
			PROCUREMENT (local & foreign supplies)		MECHANICAL COMPLETION		
				DELIVERIES (equipment & materials)			
				CONSTRUCTION (ammonia,urea,NA,NP plants,utilities, offsites inclusing gas gathering and marine facilities)			
					COMMISSIONING (phased commissioning of complex)		
						PRODUCTION BUILD-UP (ammonia,urea,NA,NP plants)	

3.4. Counterpart Support Capacity

Pending clarification

FERTILIZER INDUSTRIAL SYSTEM IN TANZANIA
LIST OF TECHNICAL ASSISTANCE/INVESTMENT PROJECT DOCUMENTS

1. TECHNO-ECONOMIC APPRAISAL OF THE VIABILITY OF REHABILITATION, REVAMPING AND DIVERSIFICATION OF PRODUCTION PROGRAMME IN TFC FERTILIZER COMPLEX AT TANGA.

   The project aims at preparing a diagnosis of the technical and economic viability of the complex under a diversified production programme. Assuming a positive diagnosis, consultancy services connected with contracting, construction, commissioning and staff and management training at Tanga would have to be foreseen in the second phase of the investment project. The second phase aims at a production capacity increase to match consumption of fertilizers in Tanzania.

   Approximate cost to be borne by UNIDO: US$ 300,000.

   Implementation period: 1990-1994.

2. ESTABLISHMENT OF THREE FERTILIZER STORAGE FACILITIES, AT DAR ES SALAAM, SONGEA AND MAKAMBAKO.

   The project aims to eliminate bottlenecks in handling, transport, storage and distribution of fertilizers in Tanzania.

   The project requires the preparation of the request to financial donors.

   Approximate cost to be borne by UNIDO: US$ 50,000.

   Implementation period: 1990.

3. State Mining Company - FEASIBILITY STUDIES ON RAW MATERIALS RELATED TO FERTIS DEVELOPMENT.

   A project related to surveying, mapping, appraisals and exploration of phosphate rock in the Minjingu Phosphate Mine which delivers rock to the TFC complex at Tanga. Other deposits, of apatite, phosphate and pyrites will also be examined in order supply the fertilizer industry with domestic raw materials.

   The diagnosis of Minjingu deposits is of key importance for decisions on the revamping of the TFC complex at Tanga.

   Approximate cost to be borne by UNIDO: US$ 3 million.

   Implementation period: 1990-1993. Diagnosis on Minjingu deposits should take place in 1990.

4. Tanzania Petroleum Development Corporation - TECHNO-ECONOMIC APPRAISAL OF A DIVERSIFIED PRODUCTION PROGRAMME AT THE KILWA MASOKO NITROGEN FERTILIZER COMPLEX.

   The project is an alternative scenario to the Government programme related to the export-oriented world-scale ammonia/urea complex at Kilwa Masoko.

The aim of the project is to analyse the techno-economic viability of the complex for import substitution and the scope for sub-regional co-operation in East African countries in this industry. A more diversified production programme (including urea AN, CAN and NP fertilizers) is to be examined.

Approximate cost to be borne by UNIDO: US$ 150,000.

Implementation period: 1990-1991.

5. RESEARCH ON AFFINITY TO LOCAL SOILS AND CROPS OF FERTILIZERS TO BE PRODUCED IN A DIVERSIFIED PRODUCTION PROGRAMME AT TANGA AND KILWA MASOKO.

The project aims at defining optimum relations, ratios, fertilizer types and application rates in order to achieve the most appropriate production programme at Tanga and Kilwa Masoko. The project could be undertaken through joint research of FAO in Dar es Salaam and the National Soil Institute in Tanga

Approximate cost to be borne by FAO/UNIDO: US$ 1 million.

Implementation period: 1990-1992.

6. INVESTMENT PROMOTION CONFERENCE CONNECTED WITH TANGA AND KILWA MASOKO PROJECTS.

In order to place the Tanzanian Government and its organizations in contact with prospective licensors, contractors, donors, the World Bank, African Development Bank, FAO and UNIDO, there is a need to hold an investment promotion conference to get information on the possibilities of attracting foreign capital to fertilizer projects in Tanga and Kilwa Masoko.

The conference might also cover the other projects related to the chemical industry in Tanzania, or be totally confined to fertilizer industry development in South-East Africa.

Approximate cost to be borne by UNIDO: US$ 200,000.

Implementation period: 1990-1991.

The total approximate cost to be borne by UN agencies in Tanzania is US$ 4.7 million.